THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

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"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

"................. per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hìc carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 109. JANUARY 1887.

I.—*On some new or imperfectly-known Species of Stromatoporoids.* By H. ALLEYNE NICHOLSON, M.D., D.Sc., Regius Professor of Natural History in the University of Aberdeen.—Part III.

[Plates I.–III.]

Clathrodictyon vesiculosum, Nich. & Mur.
(Pl. I. figs. 1–3.)

Clathrodictyon vesiculosum, Nicholson and Murie, Journ. Linn. Soc., Zool. vol. xiv. p. 220, pl. ii. figs. 11–13 (1878).
Clathrodictyon vesiculosum, Nicholson and R. Etheridge, Jun., Mon. Sil. Foss. Girvan, p. 238, pl. xix. fig. 2 (1880).
? *Stromatopora striatella*, M'Coy, British Palæozoic Fossils, p. 12 (1851).

Cœnosteum forming laminar expansions, often of large size, having the lower surface covered by a concentrically-striated and wrinkled epitheca. Full-sized individuals may be from 6 to 9 inches in diameter and an inch or more in thickness. The upper surface is irregularly undulating, without "mamelons," and exfoliating concentrically round the elevated points. Well-developed astrorhizæ are present; but the central canals

of these do not open on the surface by prominent apertures. As regards minute structure, the cœnosteum is made up of closely-set horizontal laminæ, which are only slightly or not at all undulated, but which are minutely crumpled, so as to give rise to more or less imperfect radial pillars. The radial pillars are invariably confined to their respective interlaminar spaces, and are therefore not "continuous." The interlaminar spaces are broken up into minute, often imperfect, lenticular cells, which are essentially formed by curved inflections of the concentric laminæ.

In general, from eight to ten interlaminar spaces or from nine to eleven laminæ occupy the space of 1 millim.* The cells formed by the radial pillars or by the bendings of the laminæ are very variable in size, but are mostly from $\frac{1}{8}$ to $\frac{1}{10}$ millim. in length.

Obs. C. vesiculosum is the type species of the genus *Clathrodictyon* †, Nich. & Mur. As in all the species of the genus, therefore, the radial elements of the skeleton are incompletely developed, and never extend from one interlaminar space into another. While the radial pillars are thus imperfect, the concentric laminæ of the cœnosteum are minutely undulated, and the interlaminar spaces thus become broken up and subdivided into vesicles, the size and shape of which are exceedingly variable. Hence vertical sections of *C. vesiculosum* (Pl. I. figs. 1 and 3) show a minutely vesicular structure, the cœnosteum appearing to be made up of minute lenticular cells, arranged in horizontal or slightly curved

* It should be understood that all such measurements as the above are approximate and not absolute. They are true of one particular specimen; but even within the limits of a single slide the number of interlaminar spaces and laminæ in a given space is not absolutely constant. Still more is there a want of complete uniformity when we examine slides taken from different examples of the same species. Nevertheless, in spite of a considerable range of individual variability, each species exhibits a sufficient constancy in the *average* distance at which its component laminæ are placed apart to render this character available in specific determination.

† The genus *Clathrodictyon* is distinguished from *Actinostroma* (*Stromatopora*, auctt.) by the fact that the radial pillars are restricted to their respective interlaminar spaces, instead of being "continuous." They also do not give out whorls of radiating "arms," and hence we do not see in tangential sections the "hexactinellid" structure so characteristic of species of *Actinostroma*, though an approach to this is seen in some species of the genus (*e. g.* in *C. regulare*, Ros., sp.). The surface in the species of *Clathrodictyon* is usually smooth or gently undulated and mostly without definite prominences or "mamelons;" these structures are, however, not universally absent, as I formerly supposed (Mon. Brit. Strom. p. 77), but are present, occasionally or constantly, in two species of the genus.

rows. On the other hand, tangential sections (Pl. I. fig. 2) show the cut ends of the isolated and imperfect radial pillars along with the irregularly divided edges of the concentric laminæ. Tangential sections also show no traces of radiating "arms" springing from the radial pillars. Small astrorhizæ are seen in tangential sections, and these usually have a wall-less central canal; but the openings of the latter on the surface are not prominently elevated.

C. vesiculosum *, Nich. & Mur., belongs to a series of forms the specific determination of which is exceptionally difficult. The forms in question, viz. *C. vesiculosum*, Nich. & Mur., *C. variolare*, Rosen, *C. Linnarssoni*, Nich., and *C. crassum*, Nich., are all easily recognized as distinct when typical examples are selected for examination. It is therefore expedient to distinguish them by separate specific names. At the same time there are close relationships between all these forms, and examples are not uncommon which show intermediate characters, and which therefore it is difficult to refer definitely to any one of the four. In a less striking form a passage may also be traced between this group of types and *C. fastigiatum*, Nich.

From the forms above mentioned *C. vesiculosum* is best distinguished by the extreme closeness with which the concentric laminæ are set and the resulting minuteness of the cells which compose the cœnosteum. Not only are the laminæ exceedingly close, but the interlaminar spaces are nearly equal in width, and the cellular tissue of the skeleton is thus approximately uniform. On the other hand, in typical examples of *C. variolare*, Ros., the interlaminar spaces are unequal in size—wide spaces alternating tolerably regularly with spaces which are much narrower than the average and which are usually arranged in groups (Pl. I. fig. 5). In *C. Linnarssoni*, Nich., again, the concentric laminæ are much less crumpled, and the cells of the interlaminar spaces are

* From a recent paper by Dr. Rominger (Proc. Acad. Nat. Sci. Phil. 1886) I gather that this observer had given the name of *Stromatopora minuta* to the present species many years ago (1871) in a memoir in which a number of Stromatoporoids were described and named. As the memoir in question, however, was never published (and is still unpublished), this name has, of course, no validity. The same observation applies to a number of additional names given by Dr. Rominger in the same memoir to various Stromatoporoids, which have been subsequently described and named by other authorities. As the non-publication of the memoir in which these names were originally given deprives the same of all force as against names *published prior to* 1886, it is not altogether easy to see the object gained by the reproduction of these MS. titles at the present day.

therefore much more nearly quadrangular than is the case in *C. vesiculosum*. The form which I have named *C. crassum* is sufficiently distinguished by the comparatively small number of laminæ in a given space and by the great thickness of the skeleton-fibre. Lastly, *C. fastigiatum* is sufficiently separated from the present species by the much greater width of the interlaminar spaces and the chevron-like folding of the concentric laminæ.

Formation and Locality. So far as known, the species is wholly Silurian (Upper Silurian). The type-specimen is from the Clinton formation of Yellowsprings, Ohio. It occurs also in the Niagara Limestone at Thorold, Ontario, and probably at many other localities in this formation. In the Wenlock Limestone of Britain it occurs at Much Wenlock, Dudley, Ironbridge, Dormington, &c. I have also collected specimens apparently belonging to this form from the Silurian ("Zone of *Pentamerus esthonus*") of Kattentack, Esthonia, and from the "Raiküll Beds" of Raiküll. In Scotland it has been collected by Mrs. Robert Gray in the Silurian rocks of Woodland Point, near Girvan.

Clathrodictyon variolare, Rosen, sp. (Pl. I. figs. 4–6.)

Stromatopora variolaris, von Rosen, Ueber die Natur der Stromatoporen, p. 61, pl. ii. figs. 2–5 (1867).

Cœnosteum laminar, hemispherical, or massive, with a concentrically-wrinkled basal epitheca, and often attaining a large size. The surface may be smooth or may exhibit numerous "mamelons," which are sometimes small and pointed or, more commonly, low and rounded (Pl. I. fig. 4). Astrorhizæ are present, but are of small size, and do not appear to correspond in any special way with the surface-eminences or "mamelons," when these latter structures are present.

The internal structure is very similar to that of *C. vesiculosum*, the skeleton being composed of close-set concentric laminæ, which are horizontal or only slightly undulated, and are minutely crumpled, so as to give rise, along with the incomplete radial pillars, to a fine vesicular tissue. From eight to ten laminæ occupy a space of 1 millim.; but the interlaminar spaces are of unequal sizes, rows of large vesicles alternating with rows of small ones (Pl. I. fig. 5). In general, rows of large vesicles are separated by two or three rows of much smaller cells; but there may be only a single row of the latter or they may even be wanting in places. Tangen-

tial sections (Pl. I. fig. 6) exhibit the cut ends of the irregular radial pillars and the divided edges of the laminæ, but show no characteristic feature.

Obs. As before remarked, this species is closely allied to *C. vesiculosum*, Nich. & Mur., and forms intermediate between the two are not uncommon. The character which most decisively distinguishes *C. variolare* from the latter is the alternation of rows of large cells with wider or narrower zones of exceedingly minute vesicles. In other respects the two forms stand very close to one another.

Formation and Locality. So far as known, this species is wholly Silurian (Upper Silurian). It occurs abundantly in the Silurian Limestones of Esthonia, and I have collected many examples from Kattentack and between Saage and Ridaka. The species also occurs in the Wenlock Limestone of Britain (Ironbridge and Dormington); but some of the British specimens which I should be disposed to place here differ in certain respects from the Esthonian type. Von Rosen's type-specimen (which I have examined) is from Errinal, in Esthonia.

Clathrodictyon Linnarssoni, Nich. (Pl. I. figs. 7 and 8.)

Cœnosteum laminar, often of considerable size, with a finely wrinkled basal epitheca, the upper surface being smooth and seemingly without "mamelons." Average thickness in the centre of the cœnosteum about 1 inch (in the specimens examined). Small astrorhizæ are present, with wall-less vertical canals; but these do not open above by projecting apertures.

In internal structure the cœnosteum is composed of close-set horizontal laminæ, about six to eight of these occupying the space of 1 millim. The laminæ may undulate gently, but are not minutely crumpled. The interlaminar spaces are crossed by numerous, small, straight radial pillars, which often do not reach the whole way from one lamina to another, and never extend out of their own interlaminar space. The interlaminar spaces are thus broken up into numerous more or less complete cells, which are oblong or square rather than lenticular in form. Tangential sections show the cut ends of the radial pillars and the astrorhizal canals, but offer nothing specially characteristic. Vertical sections (Pl. I. fig. 7) show further the wall-less axial canals of the astrorhizæ, sending off horizontal radiating branches into successive interlaminar spaces.

Obs. This species is closely allied to *C. vesiculosum*, Nich. & Mur., and *C. variolare*, Ros. It differs from both in the want of crumpling of the concentric laminæ and in the resulting fact that the interlaminar vesicles are quadrangular rather than lenticular. It differs further from *C. vesiculosum* in the greater remoteness of the laminæ, and from *C. variolare* in the approximately uniform width of the interlaminar spaces. Dr. George J. Hinde has been good enough to submit to me a number of examples of this form from Gotland, where it seems to be common; but I have not found it elsewhere.

Formation and Locality. Wenlock Limestone, Wisby, Gotland (*coll. Dr. George J. Hinde*).

Clathrodictyon striatellum, D'Orb., sp.
(Pl. I. figs. 9 and 10.)

Stromatopora concentrica, Lonsdale, Silurian System, p. 680, pl. xv. fig. 31 (1839).
Stromatopora striatella, d'Orbigny, Prodrome de Paléontologie, t. i. p. 51 (1850).
Stromatopora mammillata, Fr. Schmidt, Sil. Form. von Ehstland, p. 232 (1858).
Stromatopora mammillata, von Rosen, Ueber die Natur der Stromatoporen, p. 71, pl. viii. figs. 1–5 (1867).
Stromatopora mammillata, Ferd. Roemer, Lethæa Palæozoica, part i. p. 531, fig. 125 (1883).

Cœnosteum mostly laminar or hemispherical, with a concentrically-wrinkled basal epitheca. Surface more or less undulated, but without definite eminences or "mamelons," the concentric laminæ usually exfoliating concentrically round elevated points. In well-preserved examples the surface shows innumerable small rounded tubercles, representing the crumpling of the concentric laminæ, and between these are minute pores. Astrorhizæ are apparently wanting.

As regards internal structure, vertical sections (Pl. I. fig. 9) show that the concentric laminæ are comparatively remote, about four interlaminar spaces, and therefore five laminæ, occupying the space of 1 millim.; but the interlaminar spaces are wider over the convexities of the undulated laminæ. The laminæ are thrown into successive undulations, which are more pronounced in some specimens than in others, but are always gentle and regularly curved. The laminæ are also regularly crumpled, in the same manner as in *C. vesiculosum*, but less completely, so that there is no appearance in vertical sections of rows of lenticular vesicles, such as are so characteristic of the latter species. Each infolding of the lamina is,

however, prolonged *downwards* * into the interlaminar space below in the form of a more or less complete radial pillar. Some of the radial pillars are quite short; others project about halfway into the interlaminar space; others cross the space and connect themselves with the lamina below; finally a few spring from the *upper* sides of the laminæ. A further very characteristic point about the radial pillars is that they are very commonly double at their bases, where they spring from their producing lamina. Tangential sections (Pl. I. fig. 10) of this species are much more characteristic than is usual in the genus *Clathrodictyon*. Where such a section traverses an interlaminar space the cut ends of the radial pillars are seen in the form of dark granular masses of considerable size and usually of a more or less elongated or oval shape. When the section more or less closely coincides with a concentric lamina, the cut ends of the radial pillars are more closely set and larger in size, and often form a sort of mosaic pavement, or at other times a loose reticulation. Tangential sections are also unlike similar sections of most species of this genus in the apparent absence of astrorhizal canals.

Obs. I shall have the opportunity of dealing more fully elsewhere with the peculiarities of the minute structure of *C. striatellum*, and need not discuss them further here. In its general features the species is one which can hardly be confounded with any other member of the genus. It is most nearly related to *C. regulare*, Rosen, but is readily distinguished by its wider interlaminar spaces and by the quite peculiar form of its radial pillars. I need only add that my identification of this form as being the one which d'Orbigny had in view in establishing his species is based upon an examination of Lonsdale's original specimen, which served as the type of the species to the French palæontologist. My identification of *Stromatopora mammillata*, Fr. Schmidt, with d'Orbigny's species is based upon specimens of the former kindly given to me by Magister Schmidt himself; and there can be no doubt as to the complete identity of the two types, such slight differences as are apparent being the result of the fact that the Esthonian specimens are silicified.

Formation and Locality. Ordovician and Silurian. So far, the species has not been recognized in the Ordovician rocks

* In the illustrations which I gave of vertical sections of this species in the introduction to the 'Monograph of British Stromatoporoids' (pl. i. fig. 1 and pl. v. fig. 3) the figures were inadvertently reversed in position, so that the radial pillars are represented as growing from the *upper* sides of the laminæ instead of from the lower, as is really the case.

except in Esthonia (in the "Borkholm'sche Schichten"). In the Silurian rocks it is a common species in the Wenlock Limestone of Britain (Dudley, Ironbridge, Dormington, &c.). I have also specimens from the Wenlock Limestone of Wisby, Gotland.

Clathrodictyon crassum, Nich. (Pl. II. figs. 1 and 2.)

Cœnosteum laminar, thin (about a centimetre or thereabouts in thickness), and of small size. The underside is covered with a concentrically-striated epitheca. The upper surface is studded with vermiculate tubercles and exhibits well-marked branching astrorhizal canals. "Mamelons" are not present.

As regards internal structure, the cœnosteum is seen in vertical sections (Pl. II. fig. 1) to be composed of nearly horizontal concentric laminæ, of which five or six occupy the space of 1 millim. The laminæ are minutely inflected and become blended with the thick radial pillars, by which the interlaminar spaces are divided into irregularly-sized oval or rounded cells. In tangential sections (Pl. II. fig. 2) the cut ends of the thickened radial pillars are seen to form a sort of loose reticulation, in which the ends of the smaller pillars usually appear as dark dots. Such sections also show numerous, large-sized, branching astrorhizal canals. The skeleton-fibre is of unusual thickness, and the width of the interlaminar spaces is therefore proportionately reduced as compared with the width of the concentric laminæ.

Obs. Without entering here into minute details, it may be stated that *C. crassum* is most nearly related to *C. variolare*, Rosen; and forms intermediate between the two are not unknown. Typical examples of the present species can, however, be at once distinguished by the coarse tuberculation of the surface and the comparatively large development of the astrorhizæ, by the excessive thickness of the skeleton-fibre, by the complete reticulation of the laminæ and radial pillars, and by the characteristic aspect of tangential sections.

Formation and Locality. Rare in the Wenlock Limestone of Britain (Dudley, Ironbridge, and Dormington).

Clathrodictyon fastigiatum, Nich.
(Pl. II. figs. 3 and 4.)

Clathrodictyon fastigiatum, Nicholson, Mon. Brit. Stromatoporoids, p. 43, fig. 3 (figure only).

Cœnosteum laminar and cake-like, of variable size, but of

small thickness, full-sized individuals having a diameter of 6 inches or more, with a thickness in the centre of an inch or less. The under surface is covered with a concentrically-wrinkled epitheca. The upper surface exhibits vermiculate and inosculating ridges, formed by rows of elongated tubercles, but is otherwise flat or slightly undulated, showing no "mamelons." Astrorhizæ are very imperfectly developed and can sometimes hardly be said to exist.

In internal structure the skeleton is composed of bent and crumpled concentric laminæ, of which about five or six occupy the space of 1 millim. As shown by vertical sections (Pl. II. fig. 3), the laminæ are bent in two ways. In the first place they are bent into numerous chevron-like foldings, no traces of which, however, can be seen on the surface of the cœnosteum. In the second place each lamina is minutely crumpled or inflected in such a way that the interlaminar spaces are constricted into rows of very imperfect and more or less open vesicles. The radial pillars are developed from the points of inflection of the laminæ, but are mostly imperfect and thin. Hence, in vertical sections, the bent and crumpled laminæ are far more conspicuous than the radial pillars. Tangential sections (Pl. II. fig. 4) exhibit the irregular and vermiculate edges of the transversely-divided and folded laminæ, the cut ends of the radial pillars appearing in these as dark rounded dots. Astrorhizæ may sometimes be recognized in tangential sections, but are always inconspicuous.

Obs. This beautiful species has certain relationships with *C. variolare*, Rosen, and specimens occasionally occur which present a mixture of the characters of the two forms. In typical examples, however, *C. fastigiatum* can hardly be confounded with any other species of *Clathrodictyon*. It is distinguished from its nearest allies (viz. *C. variolare* and *C. vesiculosum*) by the greater remoteness of the concentric laminæ and by the peculiar and constant chevron-like and angular folds into which the laminæ are thrown. The appearances presented by tangential sections are also exceedingly characteristic, and quite unlike those seen in any other species of *Clathrodictyon* with which I am acquainted.

Formation and Locality. Abundant in the Wenlock Limestone of Britain (Dudley, Ironbridge, Much Wenlock, Dormington). I have also collected examples of the species in the Silurian limestones ("Zone of *Pentamerus esthonus*") of Kattentack, Esthonia.

Clathrodictyon regulare, Rosen, sp.
(Pl. II. figs. 5 and 6.)

Stromatopora regularis, von Rosen, Ueber die Natur der Stromatoporen, p. 74, pl. ix. figs. 1–4 (1867).

Cœnosteum of small size; sometimes laminar and discoidal, with a wrinkled basal epitheca; sometimes incrusting foreign bodies. The largest specimen examined is less than 2 inches in diameter, with a maximum thickness of half an inch. The surface is smooth or slightly undulated without "mamelons," and often showing the edges of the exfoliated laminæ. Astrorhizæ are apparently absent. In well-preserved examples the surface is studded with small rounded tubercles, representing the free ends of the radial pillars, which often send out radiating horizontal prolongations, inclosing minute interstitial pores.

As regards internal structure, the skeleton is made up of horizontal or slightly flexuous concentric laminæ, of which about six occupy the space of 1 millim. The laminæ are thick, often with a median dark line, and slightly crumpled (Pl. II. fig. 5). At each point of inflection the lamina sends down from its under surface a stout radial pillar, which may only project a short way into the interlaminar space, but which, more commonly, becomes connected with the lamina next below. The interlaminar spaces thus become broken up into rows of regular oblong cells, which are about $\frac{1}{3}$ millim. in length, but vary much in this respect. Tangential sections exhibit large, rounded, dark dots, representing the cut ends of the radial pillars (Pl. II. fig. 6). These are often connected together by distinct radiating "arms," thus showing an imperfect form of the "hexactinellid" structure so characteristic of the species of the genus *Actinostroma*. Astrorhizal canals do not appear to be developed.

Obs. This species is readily recognized by its slightly inflected, thick laminæ, its stout radial pillars, the oblong form of the regularly disposed interlaminar cells as seen in vertical sections, and the presence of radiating "arms" connecting the radial pillars. In its general characters, both external and internal, it most closely resembles *C. striatellum*, d'Orb.; but it is an altogether smaller form, its skeleton is much finer, and the form of the radial pillars and interlaminar cells is quite different.

Formation and Locality. Wenlock Limestone, Dudley (rare). It occurs also in the Wenlock Limestone of Wisby, Gotland. Von Rosen's original specimen (which I have examined) is from the Silurian ("Zone of *Pentamerus esthonus*") of Kleine-Ruhde, Esthonia.

Clathrodictyon cellulosum, Nich. & Mur.
(Pl. II. figs. 7 and 8.)

Clathrodictyon cellulosum, Nicholson & Murie, Journ. Linn. Soc., Zool. vol. xiv. p. 221, pl. ii. figs. 9 & 10 (1878).

Cœnosteum massive, or in the form of thick laminæ. Under surface not observed. Upper surface covered with pointed tubercles, representing the upper ends of the radial pillars, often connected with one another to form sinuous irregular ridges.

In internal structure the skeleton is composed of remote, horizontal or slightly flexuous concentric laminæ. On an average two interlaminar spaces, and therefore three laminæ, occupy the space of 1 millim. The laminæ are minutely crumpled or inflected, so as to give rise to oval interlaminar cells which vary in length from about half a millim. up to 2 millim. or more. The radial pillars look as if formed by the inflections of the laminæ; but the interlaminar cells are often crossed by delicate partitions ("interlaminar septa"), which are independent of the proper radial pillars (Pl. II. fig. 7). The skeleton-fibre is thick and has the aspect, in vertical sections, of being penetrated by fine vertical tubuli. Tangential sections (Pl. II. fig. 8) exhibit the remote, oval or round, cut ends of the radial pillars, mostly connected by sinuous lines representing the divided edges of the concentric laminæ. Astrorhizæ are apparently not developed.

Obs. This species is at once distinguished from all the other forms of *Clathrodictyon* by the coarseness of the skeletal framework. The entire skeleton, in fact, appears in vertical sections to be made up of rows of large oval vesicles. Tangential sections are also highly characteristic.

Formation and Locality. Not uncommon in the Corniferous Limestone (Devonian) of Port Colborne and other localities in Western Canada.

Clathrodictyon ostiolatum, Nich.
(Pl. III. figs. 1–3.)

Stromatopora ostiolata, Nicholson, Ann. & Mag. Nat. Hist. ser. 4, vol. xii. p. 90, pl. iv. figs. 1, 1*a* (1873); Rep. on the Palæontology of Ontario, p. 63 (1875).

Cœnosteum massive, composed of concentrically laminated parallel cylinders, which are more or less enveloped by laminæ concentric with the entire colony, and which terminate superficially in blunt nipple-shaped prominences. Under surface unknown. Surfaces of the laminæ smooth or with exceed-

ingly fine granulations, without tubercles or "mamelons." Astrorhizæ well developed, each system having a vertical, wall-less, axial canal, which opens on the surface of the laminæ by a slightly projecting round aperture (Pl. III. fig. 3).

As regards internal structure, the skeleton is composed of exceedingly delicate concentric laminæ, about five of which occupy the space of 1 millim. (Pl. III. fig. 1). The laminæ are curved, in conformity with the curvatures of the fossil, but are not at all, or but slightly, inflected or crumpled. Each lamina gives off downwards numerous close-set and delicate radial pillars, which may or may not reach the lamina below. The interlaminar cells are thus more or less quadrangular in shape, though often incomplete. Tangential sections (Pl. III. fig. 2) exhibit minute rounded or oval dots, often almost linear, representing the cut ends of the radial pillars. When the section coincides with the plane of one of the concentric laminæ these dots are replaced by a delicate reticulation.

Obs. Owing to dolomitisation, it is very difficult to prepare satisfactory sections of this species, the minute structure being considerably obscured by mineralisation. The species is, however, clearly referable to *Clathrodictyon*, and it is separated from the other species of the genus by the extreme delicacy of the laminæ and radial pillars, the form of the interlaminar cells, and the fact that the astrorhizæ open superficially by marked and projecting apertures.

Formation and Locality. The only specimen known is from the Silurian (Guelph formation) of Guelph, Ontario.

Clathrodictyon laxum, Nich. (Pl. III. figs. 4 and 5.)

Cœnosteum laminar or incrusting, a basal epitheca being present in the former case. Upper surface smooth or slightly undulated, without "mamelons," and apparently covered with small tubercles. Astrorhizæ apparently wanting.

As regards internal structure, the skeleton is composed of horizontal or slightly flexuous concentric laminæ, of which about four are placed in the space of 1 millim. (There are usually three interlaminar spaces in 1 millim.) The laminæ (Pl. III. fig. 4) are comparatively thin, and are not crumpled or inflected. The interlaminar spaces are crossed by numerous delicate vertical radial pillars, most of which reach from one lamina to the next. Tangential sections (Pl. III. fig. 5) exhibit the oval or rounded cut ends of the radial pillars along with the sinuous edges of the transversely divided laminæ.

Astrorhizæ may be present, but were not seen in the specimens examined.

Obs. This species is distinguished by its straight uninflected laminæ and straight radial pillars. The interlaminar spaces are therefore not subdivided into rows of vesicles, as is usual in the species of *Clathrodictyon.* The comparative remoteness of the laminæ is also a good distinguishing character, the interlaminar spaces being wider than in any other type of the genus known to me, with the exception of *C. cellulosum.* Judging from the figures and description given by Dr. Frech of a Devonian Stromatoporoid which he has named *Stromatopora philoclymenia* ("Die Korallenfauna des Oberdevons in Deutschland," Zeitschr. d. Deutschen geol. Gesell. Jahrg. 1885, p. 118), I should be inclined to believe that this would prove to be a species of *Clathrodictyon*, and that it would probably be nearly allied to the present species. *S. philoclymenia*, Frech, is, however, described as having laminæ decidedly further apart than is the case in *C. laxum*, the interlaminar spaces being stated to have a width of $\frac{1}{2}$ to $\frac{2}{3}$ millim. Moreover, the tangential section of the former is very unlike that of the present type.

Specimens of *C. laxum* sometimes occur with "Caunopora-tubes" traversing the cœnosteum, and in one such specimen, submitted to me by Dr. George J. Hinde, these tubes exhibit well-marked septal spines.

Formation and Locality. Corniferous Limestone, Port Colborne, Ontario. Also in the same formation, at Kelley's Island, Ohio.

Clathrodictyon retiforme, Nich. & Mur., sp.
(Pl. III. figs. 6–8.)

Stylodictyon retiforme, Nicholson & Murie, Journ. Linn. Soc., Zool. vol. xiv. p. 222, pl. iii. figs. 1–3.

Cœnosteum massive (?); the under surface unknown; the upper surface (Pl. III. fig. 8) covered with conspicuous, pointed, conical "mamelons," which are from 1 to 2 millim. in height, and about 3 or 4 millim. apart. The surface also is thickly studded with small round tubercles, representing the upper ends of the radial pillars.

As regards internal structure, the cœnosteum is essentially composed of sharply undulated concentric laminæ; but the continuity of the undulations of these is interfered with by the large development of the astrorhizal systems. Each of these systems consists of a vertical wall-less canal, which is surrounded by loose reticulate tissue, this being, in turn, enveloped in a series of from two to five concentrically disposed laminæ.

These concentrically laminated cylinders surrounding the axial astrorhizal canals are disposed in numbers throughout the general undulated laminæ of the skeleton. It is the upper ends of these cylinders which form the "mamelons" on the surface; and one of the axial canals terminates at the summit of each of the latter. On the other hand, the lateral or radiating canals of the astrorhizal systems are very incompletely developed.

Vertical sections (Pl. III. fig. 7) show the flexured laminæ, of which from three to five occupy the space of 1 millim. The laminæ give off stout radial pillars, which mostly extend from one lamina to the next. In many cases a larger or smaller number of the radial pillars are placed one above the other in successive interlaminar spaces. This is especially the case in the laminæ which envelop the axial astrorhizal canals, and it gives to the radial pillars, where it occurs, the appearance of being "continuous." The phenomena presented by vertical sections differ, further, according as the section traverses the astrorhizal cylinders through the centre or through the circumference.

Tangential sections (Pl. III. fig. 6) show differences in structure according as they traverse the astrorhizal cylinders or the general interstitial laminated tissue. Where such a section cuts a cylinder, we see the central astrorhizal canal with its enveloping concentric laminæ. In the tracts between the cylinders we see the cut ends of the radial pillars as oval or circular dots. The character of these shows that the species is referable to *Clathrodictyon* and not to *Actinostroma*, no radiating "arms" connecting the radial pillars being recognizable.

Obs. In the general construction of its cœnosteum, the flexured concentric laminæ, the astrorhizal cylinders, and the surface-prominences, this species has the closest possible resemblance to *Actinostroma verrucosum*, Goldf., sp. The fact, however, that the radial pillars are not "continuous" and the absence of radiating "arms" to the pillars prove that the species cannot be referred to the genus *Actinostroma* at all. It was originally referred by Dr. Murie and myself to the genus *Stylodictyon*; but this reference can undoubtedly not be sustained; and the essential characters of its structure clearly point to its being placed properly in the genus *Clathrodictyon*. From all the other known species of this genus it is sufficiently separated by the peculiar construction of its skeleton, quite apart from all minute structural characters.

Formation and Locality. Rare in the Hamilton formation (Devonian), Arkona, Ontario.

Stromatoporella (?) *tuberculata*, Nich.
(Pl. III. figs. 9–11.)

Stromatopora tuberculata, Nicholson, Ann. & Mag. Nat. Hist. ser. 4, vol. xii. p. 92, pl. iv. figs. 2, 2 *a* (1873); ibid. vol. xiii. p. 8, fig. 1 (1874); Report on the Palæont. of Ontario, p. 14 (1874).

Cœnosteum of large size, laminar, the underside covered with a wrinkled epitheca. Upper surface often irregularly undulated, without "mamelons," but covered with prominent, close-set, blunt tubercles, the summits of which appear sometimes, perhaps from breakage or weathering, to be perforated (Pl. III. fig. 9). As regards internal structure, the skeleton is composed of nearly horizontal or gently flexuous concentric laminæ, of which from three to four occupy the space of 1 millim. The laminæ are not crumpled, but exhibit slight upward and downward foldings, being bent upwards at the points where radial pillars are developed (Pl. III. fig. 11). The radial pillars are placed at distances of from $\frac{2}{3}$ to 1 millim. apart, and are extremely stout; they are apparently hollow, sometimes with a central axis, and they seem as if formed by successive cone-shaped upward prolongations of the concentric laminæ. Vertical sections show the interlaminar spaces to be traversed, in addition to the proper radial pillars, by numerous curved or straight calcareous partitions, which are very delicate, and may be spoken of as "interlaminar septa."

Tangential sections (Pl. III. fig. 10) exhibit the very large oval or ring-like cut ends of the radial pillars, which are connected with one another by numerous delicate curved lines, these representing the cut edges of the "interlaminar septa."

The skeleton-fibre itself is penetrated by innumerable minute tubuli or is finely porous. Astrorhizæ, if present at all, seem to be only incompletely developed.

Obs. This very remarkable species was originally referred by me to the genus *Stromatopora*, Goldf., which was at that time believed to comprise the forms which I now include in the genus *Actinostroma*. In its general structure it certainly most nearly resembles *Actinostroma*, and it has even points of likeness to *Labechia*. It clearly cannot be referred, however, to either of these genera, and it may be an open question whether it should not be regarded as the type of a new genus. In the meanwhile I have referred it to the genus *Stromatoporella*, Nich., with which it agrees in the porous or tubulated condition of the skeleton-fibre. It also resembles certain of the species of *Stromatoporella* (e. g. *S. arachnoidea*, Nich.) in the great development of "interlaminar septa." In any case, I know of no other type of the Stromatoporoids with

which it could be confounded when its minute structure is examined.

Formation and Locality. Common in the Corniferous Limestone (Devonian) of Port Colborne, Ontario.

EXPLANATION OF THE PLATES.

[As the figures of minute structure are based upon photographs, the scale of magnification is not absolutely constant, but varies between ten and twelve times. As a rule, the enlargement may be taken as being about ten times the natural size. Where a different magnifying-power has been used, or where the figures are of the natural size, this is specially stated.]

Plate I.

Fig. 1. Vertical section of the type-specimen of *Clathrodictyon vesiculosum*, Nich. & Mur. Clinton formation, Yellowsprings, Ohio.
Fig. 2. Tangential section of the same.
Fig. 3. Vertical section of an example of *C. vesiculosum,* from the Wenlock Limestone of Much Wenlock.
Fig. 4. Surface of a broken fragment of *Clathrodictyon variolare*, Rosen, sp., of the natural size. Silurian, Esthonia.
Fig. 5. Vertical section of *C. variolare,* Rosen, from the Silurian rocks of Kattentack, Esthonia.
Fig. 6. Tangential section of the preceding specimen.
Fig. 7. Vertical section of *Clathrodictyon Linnarssoni*, Nich., from the Wenlock Limestone of Wisby, Gotland. A vertical astrorhizal canal is cut through by the section.
Fig. 8. Tangential section of the preceding specimen.
Fig. 9. Vertical section of *Clathrodictyon striatellum*, d'Orb., from the Wenlock Limestone of Dudley.
Fig. 10. Tangential section of the preceding.

Plate II.

Fig. 1. Vertical section of *Clathrodictyon crassum*, Nich., from the Wenlock Limestone of Ironbridge.
Fig. 2. Tangential section of the same.
Fig. 3. Vertical section of *Clathrodictyon fastigiatum*, Nich., from the Wenlock Limestone of Ironbridge.
Fig. 4. Tangential section of the same.
Fig. 5. Vertical section of *Clathrodictyon regulare*, Rosen, sp., from the Wenlock Limestone of Dudley.
Fig. 6. Tangential section of the same.
Fig. 7. Vertical section of *Clathrodictyon cellulosum*, Nich. & Mur., from the Corniferous Limestone of Ontario.
Fig. 8. Tangential section of the same.

Plate III.

Fig. 1. *Clathrodictyon ostiolatum*, Nich., vertical section, from the Silurian (Guelph formation) of Guelph, Ontario.
Fig. 2. Tangential section of the same.
Fig. 3. Surface of a fragment of the same, of the natural size, showing the prominent apertures of the axial astrorhizal canals.

Fig. 4. Tangential section of *Clathrodictyon laxum,* Nich., from the Corniferous Limestone, Ontario.
Fig. 5. Vertical section of the same.
Fig. 6. Tangential section of *Clathrodictyon retiforme,* Nich. & Mur. sp., from the Hamilton formation of Canada.
Fig. 7. Vertical section of the same. The right-hand half of the portion figured cuts through one of the astrorhizal cylinders near its centre; the left-hand portion traverses an adjoining cylinder near its periphery.
Fig. 8. Portion of the surface of the same, of the natural size.
Fig. 9. Part of the surface of *Stromatoporella ? tuberculata,* Nich., enlarged about twice. Corniferous Limestone, Ontario.
Fig. 10. Tangential section of the same.
Fig. 11. Vertical section of the same.

II.—*Notes on a Species of* Entalophora *from the Neocomian Clay of Lincolnshire.* By G. R. Vine.

In his paper on the Closure of the Cyclostomatous Bryozoa *, Mr. A. W. Waters refers to several peculiarities of the cell-coverings of Palæozoic species. In speaking of what he called *Entalophora rugosa,* d'Orb., from Naples, Mr. Waters says: "The most usual position for the calcareous plate which closes the tube would seem to be about the point where the zoœcial tube rises free from the zoarium" (p. 401). Remarking on the closure of the aperture in Carboniferous *Polyporæ* and *Fenestellæ,* the author refers to and quotes a previous observation, made as far back as 1878, wherein he says: "In the Cyclostomata the cells are often after a time closed by a diaphragm, in most cases some little distance down the tube"†. In all these observations I have been able to confirm Mr. Waters's statements; but there is a very great difference between the closure of Palæozoic and recent Cyclostomata.

It is not, however, for the purpose of controverting, or even of further commenting on Mr. Waters's views that I send you the present notes, but to furnish new material for the student of our fossil Polyzoa.

Through the kindness of Mr. H. Wallis Kew, of Louth, I have been able to examine in detail specimens of *Entalophora* from the Neocomian Clay at Donington-on-Bain near Louth, in Lincolnshire. Before receiving the present examples I was altogether unacquainted with species of Polyzoa from this locality, and I have searched in vain for previous records of species found in the Lincolnshire horizon. I have compared

* Journ. Linn. Soc. Zool. vol. xvii. 1884, p. 400.
† Manch. Geol. Soc. Tr. 1878, p. 2 of paper.

the fossil with well-known types of *Entalophora* from other localities, such as the Lower Greensand or Faringdon species, but I cannot identify it as belonging to any of our British types. Certainly we have in our rocks a form which I have previously recognized as *E. gracilis*, Goldf.*, but the identification is founded upon the well-known figure of Goldfuss. In Hagenow's Maestricht Bryozoa the author figures forms of *Ceriopora gracilis*, Goldf., which he names *Escharites gracilis* and *E. distans*. The characters of the cells and the arrangement of the same are different in the two figures; but in the Lincolnshire fossils both the features of the figures of Hagenow are combined in one of the specimens at least—the cell-arrangement at the bottom part of the stem like *E. gracilis*, while the top part is like *E. distans*. There is also a striking resemblance between the Lincolnshire fossil and examples of *Entalophora cenomana*, d'Orb., from Mans. I shall therefore characterize the British examples as follows:—

Entalophora gracilis, Goldf., var. —— ?

Zoarium branching, stem about one eighth of an inch in thickness, but the width increases slightly at the node. *Zoœcia* near the base arranged rather evenly in circlets; but on the upper part of the stem they are very irregular and distant. Cells certainly tubular, but the front or area is flattened, giving to the fossil a very peculiar or *Eschara*-like feature, and coarsely punctate. *Orifice* orbicular, semiorbicular, or oval, produced or depressed, but with a thick peristome. *Closure* unique (?).

Horizon. Neocomian.

Locality. Donington-on-Bain, Lincolnshire.

The closure of this peculiar fossil is very distinct and of two types:—1st, closure in the throat of the tube, that is to say a little distance from the perfect and extended peristome, as already noticed by Mr. Waters in his description of species; 2nd, a closure over a similar position in the tube, but where the front wall of the cell is curved inwards and covering the whole throat of the tube. In the latter case there is no elongation of the tube on the front side, but on the back the tube is prolonged beyond the closure. Both of these features appear to be normal and characteristic of certain cells, and the calcareous lids in both cases are punctate, but without any central or other opening than those referred to. I cannot find any enlarged cells in my specimens, and I therefore suppose that the function of these closed cells is for reproductive purposes.

* 4th B. A. Rep. Fossil Polyzoa, 1883. (Goldf. tab. x. fig. 11.)

The peristomes of the cells are also perforated, but the "tubules" in these are more elongate than those of the area.

In one of my specimens the whole length of the cell is exposed on the inner side, and the ends of the "tubules" or porous openings are also exposed on the inner walls, for these seem to have served some special purpose in the economy of the growing cell *.

Although rather familiar with the closures of Palæozoic, Jurassic, and recent Cyclostomata, I have never noticed similar features to those described above. As we are as yet only in the infancy of our knowledge respecting the developmental features of Cyclostomatous Polyzoa of past ages, all careful observations bearing on this point are valuable, especially because, as Mr. Waters says, "further examination [of species] enables me to state that the position and the character of this diaphragm may be employed as a useful specific character" †.

III.—*The Morphology of* Antedon rosacea. By P. Herbert Carpenter, D.Sc., F.R.S., F.L.S., Assistant Master at Eton College.

The 'Traité d'Anatomie Comparée Pratique' by Messrs. Vogt and Yung, which is now in course of publication both in French and in German, is described in the authors' prospectus as designed to aid the student in making an "étude approfondie" of certain selected zoological types, their structure being investigated "couche par couche, organe par organe."

The 'Traité' "sera composé d'un série de monographies anatomiques des types, résumant l'organisation animale toute entière." This is clearly a very high standard; for in the present state of zoological science a monographic description of any known type can only be properly worked out by a very detailed process of investigation, requiring the combination of various methods of research and an intimate acquaintance with the literature of the subject. In the case of those animals which possess a hard skeleton its relation to the soft parts must be made the subject of very careful investigation. The mere cutting of thin sections for histological examination is not a sufficient means of research; but the comparative osteology and the macroscopic characters of the

* See Busk, Crag Polyzoa, p. 122, and A. W. Waters, "On the Occurrence of Recent Heteropora," Journ. Roy. Micr. Soc. vol. ii. p. 390 (1879).

† Journn. Linn. Soc., Zool. vol. xvii. p. 401.

type form a most essential element in the "monographic" treatment of the subject. In no Invertebrate animals is the relation of the soft to the hard parts more complex than in the Echinodermata; and of all the members of this group the Crinoids are those in which the soft and the hard tissues enter into the most intimate relations with one another.

As this subject has been occupying my attention very closely for the past eleven years, it was with considerable interest that I examined Messrs. Vogt and Yung's anatomical monograph on *Antedon rosacea*, which is the result of their personal investigation of this type; and I regret to state that I find it to contain a very large number of serious errors, both of omission and of commission, many of which would have been avoided if the authors had taken the trouble to make themselves better acquainted with the literature of the subject.

The essential requisite of a work such as theirs, which is intended for the use of students, is the greatest possible accuracy; but it is hardly too much to say that between misprints, misstatements, and absolute anatomical blunders, there are comparatively few pages of the monograph on *Antedon rosacea* in which a correction of some kind or other will not be necessary before the work is put into the hands of the students for whose use it is intended.

The authors' inaccuracy and want of acquaintance with the literature of their subject appears in two instances at the very commencement of their account of the Crinoidea. They give a definition of the group *, in which the following passage occurs:—"Face orale portant, au centre, la bouche et l'anus dans un espace interradiaire." It has been known, however, for over forty years that there are a large number of Crinoids in which the mouth is not central, but excentric, or even marginal. Three instances of this arrangement were figured by Müller † in 1849; while I have myself frequently alluded to it and have figured several disks ‡, together with a sectional view §, in all of which the markedly excentric position of the mouth is very evident. It has been pointed out again and again during the last eight years that this is the essential character of Müller's genus *Actinometra*, and it is given as such in Claus's 'Grundzüge.' This genus contains quite one

* 'Traité d'Anatomie Comparée Pratique,' livr. vii. p. 514.

† "Ueber die Gattung *Comatula*, Lam., und ihre Arten," Abhandl. d. k. Akad. d. Wiss. Berlin, 1849, p. 245.

‡ "On the Genus *Actinometra*, Müll., with a Morphological Account of a new Species from the Philippine Islands," Trans. Linn. Soc. 2nd ser. (Zool.), 1879, vol. ii. pl. i.

§ "The Minute Anatomy of the Brachiate Echinoderms," Quart. Journ. Micr. Sci. n. ser. 1881, vol. xxi. pl. xii. fig. 14.

third of the species of recent Crinoids, and yet the mouth in this class is described as central by Vogt and Yung, without any indication whatever that this position is not an absolutely constant one in all species of *Antedon*, and does not occur at all in *Actinometra*.

This error may be described as one of omission. The next one which I shall consider is one of commission, and that of a very definite kind, betraying either a most remarkable neglect of Crinoid literature on the part of Messrs. Vogt and Yung, or a deliberate refusal to give British naturalists the credit which is justly their due. On p. 518 the authors describe the young Crinoid as a "larve à forme de *Pentacrine* (Perrier)." It is true that in the year 1884 Professor Perrier* published the results of his researches into "l'Organisation de l'animal aux trois phases: 1. de Cystidé; 2. de Pentacrine; 3. de Comatule libre, mais non encore adulte," and that he referred to "la phase pentacrinoïde;" but in attributing the origination of this term to Professor Perrier, Messrs. Vogt and Yung must be either totally unaware of, or have deliberately resolved to ignore, the following facts.

So long ago as the year 1836 Dr. J. V. Thompson † furnished to the scientific world "the evidence of *Pentacrinus* being the young of *Comatula*." In 1863 Allman ‡ referred to "the fixed *Pentacrinus* stage" of the young of *Comatula*, as described by J. V. Thompson. On the very first page of Sir Wyville Thomson's memoir on the Embryogeny of *Antedon rosacea* § he referred to the "Pentacrinoid" stage; while eleven pages of Dr. Carpenter's monograph ||, published in 1866, are devoted to the "General History of the Pentacrinoid Larva," and the term "Pentacrinoid" recurs again and again, both in this and in his three subsequent papers in the 'Proceedings of the Royal Society,' published in 1876 and 1884 respectively. M. Sars (1869), Greeff (1876), and

* "Sur le développement des Comatules," Comptes Rendus, 1884, t. xcviii. p. 444.

† "Memoir on the Starfish of the Genus *Comatula*, demonstrative of the *Pentacrinus europæus* being the Young of our Indigenous Species," Edin. New Phil. Journ. 1836, vol. xx. p 297. The entire absence of any reference whatever both to this and to the previous memoir of J. V. Thompson's is a very striking omission in Vogt and Yung's monograph. They are not even mentioned in the Bibliography, where, however, place is found for Perrier's preliminary description of a new genus which he withdrew in May 1885!

‡ "On a Pre-brachial Stage in the Development of *Comatula*, and its importance in relation to certain Aberrant Forms of Extinct Crinoids," Trans. Roy. Soc. Edin. 1863, vol. xxiii.

§ Phil. Trans. 1865, p. 513.

|| *Ibid.* 1866, pp. 726–737.

Ludwig (1877) have all adopted it; while it appears in almost every morphological paper on the Crinoids that I have written in the past ten years, and is also used in the text-books of Claus, Zittel, and other well-known writers, all published before Perrier's allusion to the "phase de Pentacrine." In fact, so long ago as 1872 Perrier himself * quoted Sir Wyville Thomson's memoir on the development of the "larve pentacrinoïde," a point which (like many others) seems to have escaped the notice of Messrs. Vogt and Yung; and it was therefore with no little astonishment that I found them attributing this term to the French professor who had imparted to them some of the results of his own observations on *Antedon rosacea* for incorporation in their monograph, his own lengthy memoir on this type not being then ready for publication. In certain cases, however, as we shall see subsequently, Messrs. Vogt and Yung express themselves very guardedly with respect to Professor Perrier's results; while some of the new facts, the discovery of which they attribute to him, should in reality be credited to Dr. Carpenter or to some other of his fellow-workers. Like Perrier† too they persist in employing *Antedon* as a masculine name, although the researches of Mr. Spedding led him to the conclusion, which he published nearly ten years ago ‡, that it is really feminine; and it has been repeatedly used in this sense by Pourtalès, Ludwig, Duncan and Sladen, F. J. Bell, J. V. Carus, and myself.

Like most of their predecessors, Messrs. Vogt and Yung recognize an antero-posterior plane in the organization of a Crinoid, which passes through the mouth and anus and along one ray. But in the figure which they give of the *Antedon*-disk on p. 521 they do not place the anal interradius downwards, as is done by Sladen, Bell, and myself, and by almost all palæontologists, *e. g.* Schultze, Meek and Worthen, Zittel, Wachsmuth and Springer, &c.; and the bilateral symmetry of the Crinoid type is thus rendered much less apparent to the student than it really is.

Every writer who has hitherto figured sections of an entire *Comatula* has represented it in its natural position, *i. e.* with the mouth upwards—*e. g.* Müller, Greeff, my father, Ludwig,

* "Recherches sur l'Anatomie et la Régénération des Bras de la *Comatula rosacea*," Arch. de Zool. expérimentale et générale, vol. ii. 1873, pp. 46, 64.

† Although the feminine gender of *Antedon* (or more correctly *Anthedon*) was determined in 1877, Perrier used it as a masculine noun till as late as 1884, though he has since discovered his mistake.

‡ 'Nature,' vol xv. 1877, p. 366.

Teuscher, Marshall, and myself. Messrs. Vogt and Yung, however, write as follows on p. 520:—"Dans toutes les descriptions qui vont suivre, nous nous représenterons donc l'animal comme couché sur la face ventrale, le sommet du calice étant tourné en haut. Cette position, inverse de celle qu'affecte la Comatule à l'état de Pentacrine, est la seule par laquelle nous pouvons faire congruer son anatomie avec celle des Stellérides et des Échinides, chez lesquels tout le monde admet cette position comme étant normale, où tous les anatomistes parle de l'intestin montant depuis la bouche, du canal pierreux descendant depuis la face dorsale, etc."

Messrs. Vogt and Yung's vertical sections of the calyx therefore represent the cirri as growing upwards from the centro-dorsal, or "en l'air," to use a military expression. No figure at all is given of the natural position of a *Comatula*, and the student is therefore liable to gain an entirely erroneous idea about the functions and relations of the cirri. On p. 544 the authors speak of "plaçant la Comatule dans sa position anatomique normale, le disque en bas, la coupole avec les cirrhes en haut," and are then obliged to describe the gullet as "se dirigeant obliquement en haut et en arrière, vers l'espace interradial anal."

The student of comparative anatomy who is advanced enough to use Messrs. Vogt and Yung's monograph, but is unable to understand that a Crinoid is simply an inverted Starfish, and that the gullet *descends* into the stomach instead of *ascending*, must be a somewhat remarkable person. Since the Crinoid is the first type of the Echinodermata which is brought before his notice, it seems a curious plan to tell him that the *Comatula*-sections are all represented upside down, in order to "congruer" the anatomy of a Crinoid with that of other types which he has not yet studied.

To speak of an inverted *Comatula* as being "dans sa position anatomique normale," even as compared with the other Echinoderms, is to use a designation which cannot be better described than by the terms which the authors themselves employ with reference to another anatomical name introduced by Dr. Carpenter, viz. "éminemment impropre."

It will be very interesting to see how far the authors will allow this principle to carry them when they come to deal with the Holothurians, Cirripedes, and above all with man as compared with Vertebrates which do not walk erect. Which is his normal anatomical position? No comparative anatomist has yet represented his human dissections as otherwise than in the erect position. Why should not the Crinoids also be figured in the natural position which they occupied during

life? Would Messrs. Vogt and Yung figure a vertical section of *Pentacrinus* or *Rhizocrinus* with its mouth downwards and its stem "en l'air"?

Another illustration of the authors' want of acquaintance with the recent Crinoid literature which has not emanated from the pen of Professor Perrier is afforded by the following passage on p. 571:—

"Les Comatulides libres (*Antedon*, *Actinometra*) offrent fort peu de différences anatomiques, et sauf quelques détails insignifiants, sont construites absolument sur le même plan que notre espèce type."

My comments on this passage shall be put in the form of a series of questions.

1. Is it a "détail insignifiant" that more than half the arms, with the majority of the pinnules in some forms of *Actinometra*, have neither ambulacral groove, tentacles, nor ventral nerve? This fact was first published in 1876, and has been since noticed over and over again in papers on Crinoids which are included in the bibliography given by Messrs. Vogt and Yung.

2. Is it a "détail insignifiant" that the sacculi which Messrs. Vogt and Yung describe as parasitic "zooxanthelles" are never found in the exocyclic *Actinometra*, even when living side by side with *Antedon* in the same locality, though they occur in three other endocyclic Comatulæ?

3. Is it a "détail insignifiant" that the arms and pinnules of many species of *Antedon* are provided with a very well-defined ambulacral skeleton, consisting of a double row of side plates and covering plates, the former being notched for the reception of the symbiotic "zooxanthelles;" but that side plates and covering plates are entirely absent on the arms and pinnules of *Actinometra*, even in species which have a strongly plated disk? These characters were described in 1880 and 1882 respectively.

4. Is it a "détail insignifiant" that the mouth of *Actinometra* is excentric, and that its alimentary canal makes four coils round the disk instead of one only, as is the case in all the endocyclic Crinoids?

A diagram of this arrangement was given in the Report on the 'Challenger' Crinoidea, which appeared early in the year 1885, and formed the subject of an article by M. P. de Loriol in the 'Archives des Sciences physiques et naturelles,' published in the following April at Geneva, the very town in which Messrs. Vogt and Yung are professionally engaged; while a second notice of the report was given by Professor Perrier in the 'Revue Scientifique' for May 1885.

Singularly enough, however, both these reviews and the volume which suggested them appear to have been altogether unknown to Messrs. Vogt and Yung; for the 'Challenger' Report is not mentioned in the bibliography of the Crinoidea which appeared in the autumn of 1886, eighteen months after its publication *; and on p. 571 they say with reference to the Stalked Crinoids that "les seuls travaux détaillés sur l'anatomie sont: celui déjà ancien de J. Müller sur le *Pentacrinus caput Medusæ* de la mer des Antilles, et celui plus moderne de M. H. Ludwig sur la *Rhizocrinus lofotensis*." Continuing their comparison of the Stalked Crinoids with the typical *Comatula*, they say:—

"Il résulte de ces travaux que les organes du disque, des bras et des pinnules sont disposés en général, sur le type des Comatules. . . . . *En revanche, il y a des conformations conservées qui ne sont que passagères dans la larve pentacrinoïde des Comatules. Il n'y a qu'un seul pore calycaire, réuni par un sac à un seul tube hydrophore.*" And after giving other details of the resemblances between the adult *Pentacrinus* or *Rhizocrinus* and the *Comatula* larva, they add:—"C'est un des plus beaux exemples de la conservation de caractères embryonnaires dans des animaux adultes."

Now, although the authors do not state the fact in so many words, they certainly imply that in the Stalked Crinoids, as known from the researches of Müller and Ludwig, there is only one water-pore and only one "tube hydrophore," just as in a certain stage of the *Comatula* larva. I do not know what other meaning can be attributed to the passage which I have italicized. But, according to the descriptions of Professor Perrier †, the developmental stage of *Comatula* in which only one water-pore is present is the "phase de Cystidé," in which the arms are not developed. These do not appear till the "phase de Pentacrine," when there are five water-pores, one in each interradius; and as Ludwig's observations show that this condition is permanent in *Rhizocrinus lofotensis*, Messrs. Vogt and Yung would have done better to refer to this later developmental stage rather than to the pre-brachial "Cystid phase" as an illustration of the "conservation des caractères embryonnaires dans des animaux adultes."

Will they name a single Stalked Crinoid which resembles the Cystid phase of *Antedon* in having but one water-pore and water-tube? Do they not know that there are never less

* It may be well to state here that I was unable to obtain Livraison 8 of the 'Traité,' which contains the bibliography of the Crinoidea, till Oct. 25, 1886.

† 'Comptes Rendus,' 1884, t. xcviii. pp. 444, 445.

than five, and that *Rhizocrinus* is the only genus which has so few? Are they not aware that forty years ago Müller not only described but also figured a large number of water-pores at the sides of the ambulacra in *Pentacrinus* *, and that I noted the presence of several pores in *Bathycrinus* and *Hyocrinus* in 1882 †? The same character was described as occurring in *Holopus* and *Metacrinus* in the 'Challenger' Report; and, as a matter of fact, *Rhizocrinus* is the only Stalked Crinoid which at all resembles the *Comatula* larva, and this in having not one, but five water-pores!

Messrs. Vogt and Yung have illustrated their 'Monograph' by a number of woodcuts which admirably represent the structure of *Antedon rosacea*; and I am glad to be able to speak of these figures in terms of unqualified praise. It is unfortunate, however, that their great excellence should be marred by errors and omissions in the lettering and in the explanations of the figures which are given at the bottom of each page. Thus, for example, in the explanation of fig. 266 on p. 525 q and q^1 are transposed, while k^1 is printed h^1; in like manner in fig. 267, on the following page, the i indicating the intestine is printed as the v marking an ambulacral groove; p^2, which indicates the wall of p (cavité buccale), is marked "couche fibreuse de la paroi intestinale;" while an accidental rent, caused by the tearing away of the extensor fibres between the axillary radial and the first brachial, is marked with a sign which may be either a^1 or d^1 badly printed; a^1, however, stands for the primary radial, and d^1 is not explained at all; neither are t and e^1.

Figure 268, on page 527, is described as a "Coupe verticale passant par l'axe et la ligne antéro-postérieure, désignée par les orifices buccal et anal." In reality, however, it is not a truly vertical section at all. If it were so its dorsal portion would pass through the central capsule and show its internal chambers, with the origins of the cirrus-vessels and the axial cords of the first radials, just as is seen in fig. 267, on the previous page. This last represents a (nearly) vertical section, *i. e.* one which cuts the median plane in the calyx and is just outside the edge of the peristome on the ventral side; and it is sufficiently near to the median vertical plane to be fairly described as such without exaggeration. But the section represented in fig. 268 is very considerably oblique, for its dorsal portion passes through the extreme outer edge

* "Ueber den Bau des *Pentacrinus caput-medusæ*," Abhandl. d. k. Akad. d. Wiss. Berlin, 1843, p. 49, Taf. ii. fig. 14.

† "Notes on Echinoderm Morphology.—No. V.," Quart Journ. Micr. Sci. new ser. 1882, vol. xxii. p. 383.

of the centro-dorsal piece and through the five bundles of muscular and other fibres, four flexor and one extensor, which effect the articulation between the first and second radials. An artificial rent, caused by the tearing away of the densest part of the bundle of extensor fibres, is marked "f^1, cavités laterales de l'organe cloisonné," namely the chambers marked f in fig. 267, which are enclosed by the thick nervous envelope of the central capsule, and are in the very middle of the centro-dorsal plate. In fact the chambers of the "organe cloisonné" lie inside what the authors describe as the "anneau nerveux central;" while the space marked f^1 in fig. 268 is on the outer side of this structure, and is separated from it by almost the entire thickness of the first radial. The explanation of fig. 268 contains other serious errors. The two first radials are not specially distinguished, but are simply marked "*a*, pièces constituant le sommet du calice;" and the authors continue, "*c*, muscles qui les réunissent." These "muscles," however, unite the first radials not with one another, but with the second radials, as explained above; while the tissue uniting the two first radials laterally is marked "g^2, colonne de l'organe dorsal, effleurée." The extent of the error here involved will be evident from inspection of the (nearly) horizontal section represented in fig. 264 on p. 522. Its centre is occupied by the dorsal organ, marked g; while the structure which is marked g^2 in fig. 268 is the outermost edge of what is here marked b and described as an articular face separating the "pièces calcaires du sommet," in other words the first radials. The authors do not seem to have recognized the fact that a vertical section which passes through the articulation between the first and second radials could not possibly also pass through any part of the dorsal organ at its base, for it is not merely within the nerve-pentagon inside the first radials, but in the very centre of the calyx itself, as shown in their figs. 264 and 267.

Another gross blunder of the same kind appears in the explanation of fig. 276 on p. 550, where the fibres uniting the centro-dorsal to the first radials are described as "*b*, muscles entre le premier et le second radial." These fibres, though represented in fig. 267, are not referred to in its explanation, and the unwary student would thus be led to infer from fig. 276 that some of the cirrus-nerves pass out from the central capsule directly into the first radials, and that the arm-nerves pass at once into the second radials! If the authors had distinguished the centro-dorsal from the first radials in this figure it would have been some help to the

student; but they are both alike marked "*a*, parties décalcifiées du squelette."

We have seen that in the explanation of fig. 268 two of the first radials are described as "pièces constituant le sommet du calice;" and on p. 529 we read "les cinq *premiers radiaux* qui forment le sommet du calice," &c. But on the page immediately preceding (528) we are told that "ce sommet est occupé par un seul pièce pentagonale, la plaque *centro-dorsale*," a description which is scarcely consistent with the explanation of fig. 268; while we also read that the first radials are "fusionnées avec la plaque," although the fibres effecting this fusion are described in the explanation of fig. 276 as the muscles between first and second radials! Various descriptions are also given of the mode in which the first radials are united laterally to one another. The explanation of fig. 264 runs thus:—"*a*, pièces calcaires du sommet, séparées par des faces articulées, *b*, dans lesquelles s'engagent les muscles transversaux *c*, internes; *d*, muscles se rendant aux bras naissants." But on the next page the same parts are described as follows:—"Les pièces calcaires (*a*) du sommet du calice sont réunies par de fortes masses musculaires (*d*) et par des sutures linéaires (*b*) traversées également par des muscles (*c*)." Thus then the extensor fibres (*d*), which on one page are spoken of as uniting the arms to the "sommet," are described on the next as joining together the calcareous pieces of the "sommet;" and this same "sommet" is said on p. 528 to be occupied by only one pentagonal piece, the centro-dorsal!

The authors admit that the section represented in fig. 264 passes "un peu obliquement sur la plaque centro-dorsale." Had it been really horizontal they would have seen nothing of the three "faces articulées" (*b*), which are described on the next page as linear sutures between the first radials; while on p. 529 we are told that these same first radials are "fusionnés ensemble," and nothing whatever is said about the "muscles transversaux internes," which are marked (*c*) in fig. 264 and described on p. 530 as "puissantes masses musculaires"! Do the authors really believe that the first radials were united to the centro-dorsal and to one another by muscles, and that these portions of the calyx were movable on one another? The fibres which effect this union are altogether of a different nature from those forming the great muscular bundles which are attached in the fossæ at the ventral ends of the articular faces of the first radials and of the arm-joints (*c* of fig. 268, *f* of figs. 279 and 280). These have the usual histological characters of the muscles in other

Echinoderms, and are very darkly coloured. They are similar in all essential respects to the muscular fibres of the Ophiurids, as figured by Simroth *; while the fibres uniting the first radials with the centro-dorsal and with one another are of the same nature as those which Simroth described as effecting the various forms of synostosis between different plates in the skeleton of an Ophiurid (p. 435).

Messrs. Vogt and Yung do not give any reason for the presence of muscles between plates which are "fusionnés" with one another, and are therefore immovable, neither do they describe any articular faces on which movement can take place. As a matter of fact the fusion or synostosis is often so close that the calyx will resist prolonged boiling in strong alkali and begin to undergo chemical disintegration without the radials separating from one another and from the centro-dorsal; while any attempt to separate them by a fine knife-blade results in fracture of the whole calyx. Since the ordinary muscles outside the calyx are the very first tissues to be affected by the action of the alkali, the muscles described by Vogt and Yung within the calyx must differ from them altogether in their chemical as well as in their histological features.

It has been mentioned already that the monograph on *Antedon rosacea* which is the subject of this notice is a part of Messrs. Vogt and Yung's 'Traité d'Anatomie Comparée Pratique,' and one would therefore expect to find some notice in it of the comparative morphology of the Echinoderm skeleton. The homology of the basal and radial plates of a Crinoid with the genital and ocular plates of an Echinid is now universally acknowledged; but though Vogt and Yung make plenty of comparisons between the vascular system of Crinoids and those of other Echinoderms, they make no reference whatever to the morphology of the apical system, a point about which there is a much more general consensus of opinion than exists about the vascular system. They give a very good figure of the apical plates of an Urchin, but say not a word respecting their homology with the basals and radials of a Crinoid. In fact they make no reference whatever to the former, which is a somewhat singular omission, considering their morphological importance in the organization of the Crinoid type. The authors do, it is true, speak of the cirrus-vessels as separating from one another "pour se continuer, à

* "Anatomie und Schizogonie der *Ophiactis virens*, Sars," Zeitschr. f. wiss. Zool. 1876, Bd. xxvii. p. 440, Taf. xxxii. figs. 15–17, 20, 21, Taf. xxxiii. fig. 30.

travers la pièce basale du calice, dans les cirrhes;" * but what they call the basal piece here is the substance of the centro-dorsal, which they describe elsewhere as the single piece occupying the "summit" of the calyx. This is a considerable inconsistency; but it is only the natural result of their inverted mode of figuring and describing the Crinoid, which also leads them to say (on p. 548) that the cavities of the chambered organ "remontaient dans la tige de la larve pentacrinide lorsque celle-ci était encore fixée."

I have some doubts indeed as to whether they are even aware of the existence of basal plates in *Antedon rosacea.*

On p. 529 they say with reference to the first radials that "ils sont fusionnés ensemble et avec une mince plaque treillisseé, qui s'interpose entre eux et la plaque centro-dorsale, et qui en est séparée dans la stade pentacrinoïde. Cette partie appellée *rosette* par Carpenter, montre au milieu une excavation pentagonale à angles proéminents et arrondis." Now this rosette was shown by Dr. Carpenter to be developed by the metamorphosis of the basal plates of the early larva; and Messrs. Vogt and Yung's description of it as being separated from the centro-dorsal and radials during the Pentacrinoid stage is incomplete, to say the least of it, seeing that it is not then existent. Dr. Carpenter described the transformation of the basals into the rosette as commencing after the detachment of the young *Antedon*; and he gave figures of the calyx both of the advanced Pentacrinoid and of the young *Antedon* in which five separate basal plates are still distinctly visible and the rosette is not yet formed †.

Although the word "Rosette" as employed by Dr. Carpenter for the metamorphosed basals of Comatulæ has been used by all subsequent writers on the subject, *e. g.* Sars, Wyville Thomson, Ludwig, Marshall, Claus, Zittel, Wachsmuth and Springer, Schlüter, Weinberg, Dendy, and myself, Messrs. Vogt and Yung have seen fit to transfer it to another structure, namely a portion of the vascular system belonging to the chambered organ. It is used in this sense on p. 555, and also three times in the last paragraph of p. 548; but in the preceding paragraph we read: "La partie centrale du système nerveux (*e*, fig. 264; *g*, fig. 276) est en effet située dans le sommet de la coupole au-dessous de la rosette, dont elle est separée par un mince plafond calcaire, percé au centre par de nombreuses lacunes qui sont en relation avec l'organe cloisonné." I must confess that this sentence puzzles me. The central part of the nervous system which is marked *g* in fig. 276 is

* *Op. cit.* p. 549.

† Phil. Trans. 1866, p. 744, pl. xli. figs. 5, 6, pl. xlii. figs. 2, 6.

not the same as that marked *e* in fig. 264. The latter is rightly described in the explanation of the figure as the "anneau pentagonal du système nerveux central;" but it lies within the substance of the first radials, above the rosette in the natural position of the animal, and not within the "sommet de la coupole." On the other hand, the part marked *g* in fig. 276 really is within the centro-dorsal, or summit as the authors call it; but it is represented above the rosette (of Dr. Carpenter) in their (inverted) fig. 276, while the "mince plafond calcaire," which they describe as separating it from the rosette, whatever this may be, is nothing but the rosette of metamorphosed basals, as described by Dr. Carpenter and all his successors. I know of no other thin calcareous plate in the neighbourhood of the chambered organ which at all answers to the description of Messrs. Vogt and Yung. A portion of this calcareous rosette is excellently shown between the ventral surface of the chambered organ (*sensu strictu*) and the inner face of the first radial, and is marked *o* in fig. 276; but *o* is left without notice in the explanation of the figure; and Prof. Carl Vogt has been good enough to inform me by letter that the missing legend should run "*o*, tissu conjonctif aréolaire entourant l'organe dorsal et les cavités *c* de l'organe cloisonné."

Now this very part had been figured in the sections of Ludwig, Marshall, and myself, and in each case had been marked "Rosette" and its real nature properly explained. It was therefore with no small feelings of astonishment that I found one of the authors of a work on comparative anatomy describe a calcareous structure which is universally recognized as homologous with the genital plates of an Urchin, as "areolar connective tissue." This statement helps us to understand why a portion of the centro-dorsal piece in immediate contact with the nervous "anneau central" is lettered "*e*, mésentère."

The authors' want of acquaintance with the mutual relations of the hard and soft parts in the calyx of *Antedon rosacea* is further indicated by their description of the mode in which the great brachial nerves originate from the central nervous organ. On p. 549 they say with respect to their vertical sections:—"On voit sur ces coupes la masse nerveuse comme un gâteau à face dorsale un peu bombée, tandis que la face ventrale est un peu creuse, et lorsque la coupe a bien rencontré, comme sur notre figure à droite, l'axe d'un radial, on peut suivre la continuation immédiate et sans interruption, sous forme de nerf, de l'un des angles du gâteau dans le bras naissant." Now, if the authors had properly studied any one

of the descriptions and figures given by Dr. Carpenter, Ludwig, Marshall, or myself, they would know that a section in the axis of a radial could not by any possibility show an uninterrupted continuation of the nerve-cord direct from one of the angles of the central capsule into the origin of an arm. The arm-nerves start from the angles of the chambered organ, which are interradial, and they occupy this position on the dorsal surface of the calcareous rosette, where they bifurcate. The left branch of one fork and the right branch of its neighbour enter the same first radial, and a section through the axis of the *radial* would not therefore pass through the primary *interradial* cord arising from the central capsule. Truly radial sections, such as those figured by Marshall * and myself †, are not very difficult to obtain, and they show the relations of these primary nerve-cords very clearly; but the right side of Vogt and Yung's fig. 276 is very nearly interradial, and not radial as they state. If it were in the axis of a radial, as they say, the nerve-cord would not end abruptly, as they figure it, at the level of the "anneau pentagonal;" but it would be seen to pass on beyond this towards the second radial, as is represented on the left side of fig. 267. In like manner the left side of fig. 276, which would be interradial according to their description, is almost radial. It strikes one of the radial diverticula of the body-cavity into the calyx (axial radial canals), which is enclosed by a radial process of the rosette, the same part which is lettered *o*, but not explained, as I have already stated. Not only have the Swiss authors entirely failed to understand the orientation of their sections through the calyx, but they have altogether neglected to give any account of the remarkable way in which each radial receives nerves from two sources, while all the five double nerves of the rays are connected among themselves by two sets of commissures, interradial and intraradial, thus forming the great pentagonal commissure which is lodged within the substance of the first radials. It is true that they give a nearly horizontal section through this commissure (fig. 264), and speak of it as the "anneau pentagonal du système nerveux central," but they say not a word about the manner in which it is formed—a somewhat remarkable omission when we consider its physiological importance; while the mode in which they refer to it is calculated to seriously mislead the unfortunate student.

They make the following statement on p. 523:—"L'orien-

* "On the Nervous System of *Antedon rosaceus*," Quart. Journ. Micr. Sci. new ser. 1884, vol. xxiv. pl. xxxv. fig. 1.

† Trans. Linn. Soc. 2nd ser. (Zool.), vol. ii. 1879, pl. viii. fig. 3.

tation étant donnée, telle que nous l'avons indiquée, nous allons esquisser la situation générale des organes dans le calice, dans le but de faciliter à l'élève l'intelligence de l'anatomie de la Comatule singulièrement difficile à debrouiller. Les coupes dans différents sens constituant les principaux éléments de la dissection, nous avons indiqué, dans les figures 264 à 268, représentant trois coupes horizontales et deux verticales du calice, les mêmes objets par des chiffres identiques." Here are some instances of the way in which this most desirable object is effected :—*c*, in fig. 264, denotes the "muscles transversaux internes," *i. e.* those by which the first radials are "fusionnés" to one another laterally; while in fig. 268 it is appended to the paired muscular bundles by which the first and second radials are articulated together. In figs. 264 and 268 *a* denotes the first radials, while in fig. 267 these are marked a^1, and the centro-dorsal is denoted by *a*. In fig. 264 the figure *e* is appended to the "anneau pentagonal du système nerveux central" which lies within the substance of the first radials on the ventral side of the rosette and altogether outside the inner cavity of the centro-dorsal; but in fig. 267 *e* denotes the dorsal portion of the central capsule or nervous envelope of the chambered organ, which is situated at the very bottom of the centro-dorsal cavity in its deepest part. Do the authors really mean to imply that this is "le même objet" as the pentagonal commissure within the radials? It would seem so; for they refer to it as the "anneau nerveux central," and in fig. 276 they mark the same part *g*, with the explanation "anneau central du système nerveux." But they speak of it two pages before (p. 548) as "sous la forme d'un disque pentagonal à angles arrondis, percé au centre d'une petite rosette pentagonale aussi, et parcourue par des cloisons membraneuses étoilées, qui se réunissent au centre." The result of this indiscriminate application of the term "anneau" to the discoidal nervous centre within the centro-dorsal and to the pentagonal commissure within the radials cannot but be most perplexing to the student; and it was the less excusable since every one of these different muscular and nervous structures, which have been confused by Messrs. Vogt and Yung, were clearly differentiated by myself and distinguished by different letters in the explanations of my figures as long ago as 1879, in a memoir quoted in their Bibliography.

The authors also seem to be altogether unaware, though the fact has been known for the last twenty years, that each radial receives two nerve-cords which enter it separately by large and well-defined openings. They find, as their predecessors

have done, that sections of the second radials show ten nerve-cords, the shape of which varies according to the plane in which they are cut; but on p. 549 these ten cords are described "comme résultat définitif du travail de division accompli dans l'épaisseur des premiers radiaux;" and the authors further proceed to say that these cords correspond to the nerves of the ten arms. As a matter of fact, however, these ten cords in the second radials are really converging, and not diverging from points of division in the first radials, and each of them contributes nerve-fibres to two arms, as explained by Ludwig, Marshall, and myself and not to one only, as implied by Messrs. Vogt and Yung. The real division by which the five (double) nerves within the rays form ten (double) nerves within the arms takes place in the *third* and not in the *first* radials, as has been known for years past. Facts like these may be verified by any one who will take the trouble requisite for accurate section-cutting along particular planes of the calyx, and will further acquaint himself with the characters and arrangement of the internal canals, so that he will not be liable to errors of "orientation" like those into which Messrs. Vogt and Yung have fallen.

Reference has been made already to the axial radial canals which are enclosed between the rosette and the radials of *Comatula*, and sometimes reach the ventral surface of the centro-dorsal. Their character and relations were minutely described by myself in 1879 *. They were shown in longitudinal and in transverse section, and were clearly distinguished from the five cavities within the central capsule, which were first discovered by Dr. Carpenter †. He gave the name "five-chambered organ" or "quinquelocular organ" to the structure which had been described by Müller as a single-chambered heart; for he found it to contain "five chambers clustered like the carpels of an orange round a central axis;" and he described these chambers as being surrounded by a fibrillar envelope, which he regarded as nervous in character. Marshall ‡, again, spoke of the cavity of the centro-dorsal as lodging a sac divided by vertical septa into five radial compartments, and hence called the chambered organ; and he went on to explain how this is surrounded by a thick fibrillar investment known as the "central capsule." Ludwig had previously adopted the same terminology, and, in fact, he was the first to speak of the chambered organ without the nume-

* Trans. Linn. Soc. Lond. 2nd ser. (Zool.), vol. ii. 1879, pp. 77, 78.

† Phil. Trans. 1866, p. 738; and Proc. Roy. Soc. 1876, vol. **xxiv.** pp. 218, 219.

‡ *Op. cit.* p. 510.

rical prefix *; but he never used this expression to denote anything else than the five chambers and their central axis inside the central capsule; while he further described and figured the radial axial canals, the relations of which to the cœliac canals of the rays and arms were subsequently pointed out by myself. Their connection with the body-cavity and their distinctness from the chambers of the so-called heart were clearly recognized by Greeff, both in his figures and in his descriptions; while I am not aware that Teuscher, the only other recent original writer on the subject till the time of Jickeli and Perrier †, ever used the expression "chambered organ" at all, though he often referred to the "Kammern des Gefässcentrums," and he recognized the connection of the radial axial canals with the cœliac canals of the rays.

Messrs. Vogt and Yung, however, have figured not only the cavities within the central capsule, but also the radial axial canals, and the whole system of spaces within the calcareous network occupying the centre of the radial pentagon, together with some accidental cavities within the solid base of the centro-dorsal piece and in the radials, as "cavités dependantes de la cavité générale, et constituant dans leur ensemble l'organe dit cloisonné" ‡.

They say on p. 549, "Ce sont les espaces qu'on est convenu d'appeler, fort improprement, l'organe cloisonné;" and again on p. 530, "C'est la réunion de toutes ces excavations internes, qui sont revêtues de membranes, envoyant de cloisons transversales et dessinant ainsi un système compliqué de lacunes cloisonnées, qui composent ce que les auteurs ont appelé *l'organe cloisonné* (*Gekammertes Organ*). C'est une dénomination éminemment impropre, vu que ce n'est pas un organe, mais une suite de cavités parcourues par l'organe dorsal avec ses vaisseaux, et formant la continuation de la cavité générale du corps, du cœlôme, qui entoure les intestins." The statements contained in the first passage quoted above and in the first paragraph of the second one are inaccurate, to say the least of it. Messrs. Vogt and Yung do not name the writers who have used the term "chambered organ" in this very improper sense; but it is certainly neither Dr. Carpenter, Ludwig, Marshall, Greeff, Teuscher, Jickeli, nor myself; and with the exception of Prof. Perrier, I know of no other original

* "Beiträge zur Anatomie der Crinoideen," Zeitschr. f. wiss. Zool. 1877, Bd. xxviii. pp. 315–326.

† So far as I can understand Perrier's preliminary notes, he uses the term "chambered organ" in its original sense, and not at all in that assigned to it by Vogt and Yung.

‡ *Op. cit.* p. 550, fig. 276.

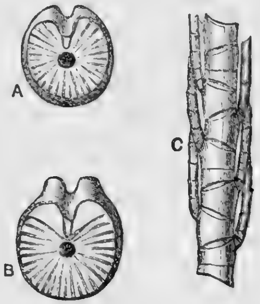
writer on Crinoid morphology who has used the expression "chambered organ" at all. The space represented in the figures to which the Swiss authors refer * is the radial portion of the body-cavity within the calyx, which is clearly distinguished from the chambers within the central capsule in all the figures given by Ludwig, Greeff, Marshall, and myself; and not one of us has ever regarded this space as a part of the chambered organ, nor, so far as I know, has any other writer on the subject. But from the mode of reference employed by the Swiss authors it would appear that Dr. Carpenter had made a great mistake which had escaped notice for twenty years, until it was rectified by Messrs. Vogt and Yung; whereas in reality they are themselves in error, because they give a meaning to his name which neither he nor any one else who used it ever intended it to bear. The term "(five-) chambered organ," as used by him and by every one of his successors till now, refers exclusively to the cavities within the central capsule, which lie on the *dorsal* side of the calcareous rosette and radial pentagon. But Messrs. Vogt and Yung erroneously interpret it as also denoting the entire system of cavities within the centro-dorsal plate and the ring of radials that rests upon it; and this is certainly not a definite organ, but a part of the general cœlom, as stated by the Swiss authors. These facts, however, were perfectly well known both to Dr. Carpenter and to his successors, and I am therefore entirely at a loss to know who the authors can be who have used the term "chambered organ" in the "eminently improper" sense described by Messrs. Vogt and Yung. The Swiss authors seem to have entirely ignored or misunderstood the writings of their predecessors, and have attributed to them a mistake which never was made; but instead of rectifying this supposed mistake they have converted it into a real one, and have perpetuated it both in their text and in the explanations of their figures. Thus in figure 276 the cavities within the central capsule on the dorsal side of the calcareous rosette and the portion of the body-cavity which is on the ventral side of this structure and enclosed by one of its radial processes are marked alike "*c*, *c*, cavités dépendantes de la cavité générale et constituant dans leur ensemble l'organe dit cloisonné." No one but Vogt and Yung has used the term chambered organ in this sense; and as they rightly speak of it as "eminently improper," one cannot but regret that it should have been employed in a text-book of comparative anatomy for the use of students.

But Messrs. Vogt and Yung go even further than this. The

* *Op. cit.*: *f*, fig. 264; *c*, fig. 276.

space on the dorsal side of the central capsule which is marked f^1 in fig. 267, and c in fig. 276, and is described in the explanation of the former figure as one of these cavities of the chambered organ, is nothing whatever but a rent in the organic basis of the floor of the centro-dorsal piece. These rents often appear in the skeletal tissues when very thin sections are cut, and I have been familiar with them for years; but I have many sections through the calyx, both of *Antedon rosacea* and of other species of Comatulæ, in which there is no trace of them. Three such undamaged sections are figured in my *Actinometra*-memoir *; and I certainly never expected to find an accidental fracture in the skeletal tissue *outside* the central capsule described as a part of the chambered organ, the cavities of which are entirely *within* this capsule, as explained above. If there really be such a diverticulum of the body-cavity within the calcareous substance of the centro-dorsal piece, as described by Vogt and Yung, *i. e.* between its inner floor on which the central capsule rests and its external surface, its presence could easily be demonstrated by rubbing away the outer surface of the centro-dorsal until this cavity was reached; and I commend this method of proving the accuracy of their anatomical descriptions to the attention of Messrs. Vogt and Yung.

It would be well also if they would use the same method to demonstrate the existence of the "cavité de la syzygie," which they represent in fig. 279 on p. 558. They describe this section as a "coupe transversale d'un bras, frisant une syzygie;" but in reality it is very considerably oblique, and so far as its dorsal portion is concerned would be classed as a bad section, owing to the large amount of skeletal tissue which has been torn away by the knife. It will be apparent from the annexed figure (C) that the plane of each syzygial face is absolutely transverse to the axis of the arm, so that a truly transverse section would pass through all the ridges radiating outwards from the central canal and show no trace of the paired muscular bundles or else show no ridges at all. But



Syzygies in the arm of *Antedon rosacea*. A, the epizygal; B, the hypozygal; C, dorsal view of an arm-fragment.

* Trans. Linn. Soc. Lond. 2nd ser. (Zool.), vol. ii. 1879, pl. viii. figs. 3, 4, 7.

Messrs. Vogt and Yung's transverse section "frisant une syzygie" shows the peripheral edge of one ridge and portions of two others; while two large muscular bundles are the most conspicuous objects in the figure. The brachial nerve is not central as it ought to be, and a large portion of the organic basis of the arm-joint, both between it and the dorsal surface and on each side of it, especially the right in the figure, has been torn away by the knife, leaving a great gap which is marked "*c*, cavité de la syzygie." Did this cavity really exist in the position figured by Vogt and Yung, it would certainly appear on the dorsal side of the axial cord in a longitudinal section of an arm. But on the opposite page of Messrs. Vogt and Yung's work to that bearing the transverse section is a figure of a longitudinal section in which there is absolutely no trace of this cavity. There could be no better proof than this of the fact that the "cavité de la syzygie" is an accidental one, the position assigned to it by Vogt and Yung being within the actual substance of the arm-joint. The same longitudinal section on p. 559 shows two diverticula of the cœliac canal towards the dorsal side with their bases resting against the skeleton. One of them is lettered *c*, and the other with a letter which is apparently meant for *c*, though it looks more like a *t*; and the explanation of the figure runs "*c*, *c*, cavités de syzygies." The *t*-like *c*, however, indicates a cavity which is not at a syzygy at all, but is merely the usual diverticulum of the cœliac canal at a muscular articulation between two arm-joints. There is a similar diverticulum at every syzygy, which is represented on the syzygial face by a groove (see woodcut, *suprà*, p. 37, A, B); but it never reaches the arm-nerve, as is well shown in Vogt and Yung's longitudinal section. On p. 560, however, they speak of this diverticulum as enlarging "vers la syzygie même, en une cavité arrondie, plate, laquelle entoure le vaisseau-nerf central, et est traversée par des canaux, disposés en rayons et formés d'un tissu fibreux en apparence élastique, ou musculaire, dont les insertions sur les teguments donnent à des coupes bien dirigées un aspect de roue."

As a matter of fact, however, the position of this supposed "cavité de la syzygie" is not anywhere in the syzygial union, but behind it, and it is occupied by the solid substance of the arm-joint, as is shown in Vogt and Yung's longitudinal section.

The authors appear to have some doubt as to the real nature of the fibres which effect the syzygial union; for while in the explanations of figs. 279, 280 they describe these fibres as the "ligaments de la syzygie," they say on the following

page that the fibrous tissue is apparently elastic or muscular; but lower down on the same page they definitely speak of the "fibres tres fines du tissu élastique," which are "isolées et ne se réunissent pas en faisceaux comme celles des muscles." Their undecided mode of reference to these fibres is a point of considerable interest, for Perrier (whom in general the Swiss authors follow through thick and thin) has described them as forming powerful muscles by which water is expelled from the arm-canals through pores at the periphery of the syzygy. The Swiss authors do not in this case use any such form of expression as "Les recherches de M. Edm. Perrier ont complètement élucidé cette question;" but they merely give a quotation from Perrier's statement of his theory without any confirmatory expressions of their own *. I have already given my own reasons for not accepting it †, and I am therefore very glad to find that such ardent admirers of Prof. Perrier's researches as Messrs. Vogt and Yung have altogether refrained from expressing their belief in it.

The Swiss authors' description of the vascular system of *Comatula* calls for a much more detailed criticism than would be at all possible at present; but one or two points may be noticed here. Speaking of the structures immediately beneath the ambulacral epithelium, they say on p. 538, "Quelque fois on y voit des écartements qui ont été pris pour l'expression d'un vaisseau dit nerveux, dont nous contestons formellement l'existence." Greeff has figured this cavity in the arm of *Antedon rosacea* ‡; and I have seen it over and over again in both arms and disk of this species, as well as in *Antedon Eschrichti*, *Actinometra nigra*, *A. parvicirra*, *A. pulchella*, and *Pentacrinus decorus*, and in the arms of *Bathycrinus Aldrichianus*. In good sections of the larger types its epithelial lining may be seen, as described and figured by Ludwig in *Antedon Eschrichti* §; and if the Swiss authors had followed his example they would have seen a good deal in the structure of the ambulacra, and more especially in that of the genital tube, which they have failed to make out in the small arms of *Antedon rosacea*.

Considering the very definite character of the intervisceral blood-vessels of this type, those namely which form a plexus interpenetrating the connective-tissue meshwork within the

* *Op. cit.* p. 561.

† "On some points in the Morphology of the Echinoderms, and more especially of the Crinoids," Ann. & Mag. Nat. Hist. 1885, ser. 5, vol. xvi. pp. 110-116.

‡ "Ueber den Bau der Crinoideen," Marburg Sitzungsberichte, 1876, no. 1, p. 20.

§ *Op. cit.* p. 267, Taf. xii. fig. 9.

body-cavity, I am somewhat surprised at finding no reference to them, either in the text or in the figures of Messrs. Vogt and Yung's monograph*. They occupy some of the "lacunes peritonéales dans le tissu spongieux vasculaire" (p. 554), and are altogether different from the channels within the threads of this tissue that Messrs. Vogt and Yung term "vaisseaux formant de réseaux," a denomination which I cannot now discuss. Their omission is the more surprising as Ludwig has given an excellent description and figure of these intervisceral vessels in *Antedon rosacea* †; while one of his figures shows their connection with the problematical dorsal organ. I well remember my father directing my attention to these vessels in *Antedon rosacea* before I ever cut any sections of the disk. He had studied them in his minute dissections with a binocular microscope, a method of research which I have often found extremely useful when applied to moderately thick sections of a large *Comatula* or *Pentacrinus*, and I have invariably found these intervisceral vessels in the disk of every *Antedon*, *Actinometra*, *Promachocrinus*, or *Pentacrinus* which I have cut into sections. Their relations to the other portions of the vascular system are fully described in the 'Challenger' report.

I am really very sorry to have been obliged to speak so strongly with respect to a work which is associated with the honoured name of Prof. Carl Vogt, and I should not have noticed it at all had it been a mere students' text-book compiled in the ordinary way; but the prefatory statement that the Traité "sera composée d'une série de monographies anatomiques de types, résumant l'organisation animale toute entière," and its publication in two languages so as to bring it within the reach of a larger number of students, necessitate its being judged by a much higher standard than that of the usual 'Lehrbuch.' In a work of this kind descriptive accuracy is absolutely essential, and it will be evident from what I have said above that, altogether apart from mere clerical errors, Messrs. Vogt and Yung's monograph is often sadly defective in this respect. Some of their statements, *e. g.* that respecting the division of the arm-nerves in the first radials, could not have been made by any one who had a proper acquaintance with the literature of the subject which was being treated monographically; while others, such as the description of rents in the skeletal tissues as portions of the system of cavities derived from the cœlom, are due to a total misapprehension of the characters of their sections.

* It is possible that the "vaisseaux coupés" which are lettered *o* in fig. 271 may belong to this system.

† *Op. cit.* p. 323, Taf. xvii. figs. 52, 56; Taf. xviii. figs. 57, 59.

A monograph of *Antedon rosacea* for the use of students has yet to be written; but we must first endeavour to arrive at some general consensus of opinion respecting the character and relations of the vascular system, not merely in the Crinoids, but also in the other Echinoderms; and I am in hopes that the researches of Perrier and Prouho, of Ludwig and Hamann, and of those English naturalists who are attracted by the subject, will soon bring this very desirable end more within our reach than it appears to be just at present.

IV.—*On the Rhopalocera of Northern Borneo.*—Part I. By W. L. Distant and W. B. Pryer.

[The butterflies here enumerated and described were collected by Mr. Pryer at, and in the neighbourhood of, Sandakan, and all notes as to the habits, times of appearance, &c. of the species are contributed by him, and are the results of his own observations. His colleague in the preparation of this paper desires to draw attention to the exceedingly close relationship of this portion of the Rhopalocerous fauna of Borneo with that of the Malay peninsula, a large percentage of the species being common to both areas, whilst where specific distinction exists it, in most cases, partakes largely of a local and racial character.]

The district of Sandakan, where a considerable number of the species mentioned were caught, is almost entirely one unbroken forest. Unbroken forest is not at all good collecting-ground for butterflies, which are very rare in its gloomy depths, while its thick leafy cover, rising 200 feet above the ground, is also but little frequented by them. The place where I chiefly resided, Elopura, having been but recently cut out of the virgin forest, the nearest clearing being twenty miles away, it was a long time before butterflies found their way there, consequently my opportunities for collecting were not so good as if I had been in a more cleared part of the country. As all the surrounding district is flat land the sameness of the vegetation causes a sameness of insects; an exploration of the high land in the interior would no doubt bring to light a largely different fauna.

Some distance up the rivers there are many old abandoned village sites in all stages of low regrown jungle, and whenever I found myself in such a locality a fair take of butterflies was always the result. A collector in the tropics,

however, should not indulge too great expectations of what he hopes to catch. The glowing pictures of abundant insect-life which most travellers, and not a few naturalists, draw, have been but very rarely realized in my experience. When once the more common species have been obtained, it is difficult, under ordinary favourable circumstances, to catch more than ten specimens that you require in a day, and not even that if you are at all unlucky. I remember on one occasion, in the Philippine Islands, at a place where the forest was a good deal opened up with clearings (just the place for butterflies apparently), on three consecutive days I only took four that I wanted. The great thing for a collector to find is some well-situated and attractive bush or creeper in flower; there he will catch in one day more butterflies, and choicer ones, than in a week's collecting anywhere else. Strange as it may seem, such an attraction is but rarely found; when it is, however, the fun is fast and furious, twenty or more butterflies are always in sight at once, and the difficulty is to pick out those you want from the crowd of commoner ones. *Papilio* dashes about at full speed, settles only for a few seconds at a time, and, with elevated quivering wings, rapidly sips at the blossoms with its long proboscis. *Parthenos* sails by on down-pointed nearly stationary wings or keeps flying from and to the flowers in small circles and indulges in frequent fights with its own species. *Pieris* flies from flower to flower rather quietly. *Hestia*, with slow flaps and an occasional soar, keeps aloof from the flowers, but is nearly always to be seen in their close neighbourhood. *Ornithoptera* usually soars high aloft, not frequently settling, but generally manages sooner or later to bring itself within reach of the net. *Hesperia* shoots with an almost invisible bullet-like flight from flower to flower and stands on them for a few seconds at a time, with rapidly vibrating wings; many small *Lycænæ* flit in and out amongst the leaves, settling on flowers usually in the shade. With the exception of the handsome *Cethosia* and one or two others the bulk of the Nymphalidæ do not seem to come much to flowers, though *Cirrochroa* is generally to be seen flying rather rapidly past in a straightforward sort of way, while an *Athema* or two may be caught in the course of the morning. If *Hypolimnas*, *Neptis*, or *Euthalia* are seen it is more because the position is a favourable one than that the flowers are an attraction. As the bush is usually some 25 feet high, and butterflies frequent the top more than the lower portions of it, the collector very soon finds that he has strained the muscles of the back of his neck and made himself dizzy by looking upwards and following the movements of the insect he

more particularly wants, as they all dash, and circle, and twist' and dance about together, usually just out of his reach, the result frequently being that while endeavouring to single out one from the quantities of commoner things, others just as good dash from behind over his shoulder, or pass in some other such way, that he rarely gets a strike at them. At such a bush lately I caught over thirty kinds of butterflies fresh to me in five or six days, and this after collecting off and on for the last eight years in neighbouring districts. The profusion of species in the tropics is so great, in fact, that one rarely takes a walk in a fairly good locality without either noticing or taking something fresh.

All flowers are not equally attractive, so that when once a bush of the kind is encountered the collector should just stick to it regularly till its bloom is over. I have but once or twice found such a bush, and only on the occasion noted above was I able to visit it on more than one day. When travelling up rivers some of the creepers which drape the trees on the edge of the water are occasionally seen in blossom : there is one of these of a bright scarlet which is much frequented by butterflies ; this bloom is in a pyramidical shape, 15 or 18 feet in breadth at the bottom and narrowing upwards to a height of 60 feet or so above the water, the whole front being alive with butterflies.

Besides flowers there are few other things that are much frequented by butterflies. Some of gross tastes are attracted by various decaying substances, while chewed sugar-cane placed in forest-paths will always bring some species to it. If staying long at any place in the forest it sometimes pays to fell an acre or so of virgin forest in the neighbourhood of clearings ; butterflies which get above the top of the forest are much in the predicament of being at sea, and will make for and fly down into a clearing as a man adrift in a boat would steer for an island. If too far away from old clearings, however, most of the wanderers will have come to grief or spread too much before flying close to it, and it will be months before many butterflies have found it out ; but such a vast unbroken virgin forest as this implies is rarely found anywhere except in one part of Borneo.

I have very nearly abandoned the idea of there being such a thing as a really rare butterfly. However much one may prize some special specimen which stands alone in one's cabinet, for years may be, the time comes sooner or later that a locality is found where it is abundant enough, or some brother collector from a distance tells you that your rarity is one of his "commonest things."

One noticeable feature about collecting in the tropics is the very few larvæ seen, and it soon becomes apparent to the observer that only those species can exist which have some very special means of protection or of concealment—the latter being the safeguard of many more species than the former, which accounts for the very few larvæ found. The enemies of larvæ are so numerous that it really seems wonderful how any can escape at all with the numbers of spiders, ants, wasps, ichneumons, mantises, &c. continually searching every leaf and twig in hopes of prey. If England by a miracle could have these insect-destroyers moved over to it for a couple of years in the same numbers in which they exist in the tropics, the consequence would be the entire blotting-out of the greater part of our insect-fauna. It is rather curious, however, that some of these exterminators are themselves in turn subjected to the most ruthless persecution; and nothing is more curious than to see the huge hunting-spider common in houses hunted by a small *Chryseis*, which, after a more or less exciting and lengthy chase, generally manages to settle on its back, sting it, and then drag it off to furnish food for its young in the future; the "come into my parlour said the spider to the fly" poem of one's youth suffers a rude reversal.

It is chiefly in the larva stage that butterflies suffer from their enemies. Moths are ruthlessly eaten by birds by day and by bats at night; but I have never once in a twenty years' experience seen a butterfly taken by a bird.

The number of moths in the tropics is enormous; the best way to get a good idea of them is, if time and money afford, to make a felling in the forest, the further away from the nearest clearing the better, and there have a hut erected: native huts usually run up in a peak to the top of the roof, without any ceiling; but if you like to put a ceiling of white cloth over the room so much the better; and at night a bright light will attract a simply uncountable number of moths, and on every night that is not too bright the same thing will occur until the bats find their way over from the nearest clearings. In a clearing frequented by bats scarcely any moths come to light at all. In a house in a new clearing in the forest I have seen the floor and table in the morning simply covered with the wings of moths which have flown in and settled on the roof inside, where they have been caught and eaten, principally by hunting-spiders.

One thing the collector may feel pretty sure about—he will see a great many more species than he will catch. Most of the butterflies in the tropics fly very fast; many of them fly

high, and, owing to the rough ground, tree-stumps, &c., running is almost an impossibility, so that with such of them as do come within reach one strike as a rule is all that is obtained, and it is better if possible to wait until they settle somewhere and then try to stalk them. Another difficulty is that many of them distinctly dodge the net when struck at, necessitating a net very much larger than is generally used in England. Another great nuisance to the collector is the number of thorns of all kinds, particularly those of the rattan-palms, so that, while keeping an eye on the butterfly you are after, you have to have a sort of general consciousness of the spot on which you are going to step next and the foliage through which you are carrying your net.

One reason accounting for the large numbers of butterflies that are sent from the tropics is found in the fact that there is no cessation to the collecting-season there. Whereas in England three and a half months a year is about all the butterfly-collector gets, in the tropics you can go on adding to your collection day after day, year in and year out.

Some genera are common in one place or situation, some in another; but those frequenting one set of situations are not often found in places much differing in character, the amount of sunshine determining each set of situations. These may be classified as follows:—places exposed to the full blaze of the sun; places where bushes more or less break the sun's full force; places surrounded with trees, but in themselves fairly open, such as large forest-paths, small openings in the forest, and so forth; situations partly shaded; situations nearly entirely shaded, but where the sun's rays manage more or less to struggle through; and deep forest. Bushes along river-banks in full sunshine also seem to be frequented by several species not often seen elsewhere. All these places have their separate *habitués*, the habits of the several species of a genus being usually identical; and though some are common to more than one situation, while others wander more or less, those frequenting one such place are not found in any other. Deep gloomy forest, which in North Borneo covers by far the great bulk of the country, is the least frequented of any, one or two species of not common Morphinæ being almost the only things found there. *Thaumantis* comes next perhaps in its preference for heavy forest. *Erites* and *Ragadia* also like considerable shade. In places where the sun gains limited entrance Lycænidæ of various species are always to be found, as well as all the Erycinidæ I know, and some of the *Euthaliæ*; and as places with more sun are sought the number of butterflies increases. It is on the sunlit

edge of forest that the greatest quantity and variety of butterflies are to be found, nearly all species preferring the neighbourhood of trees to absolute open land; but even in the places most open to the sun not a few species, and these usually abundant ones, are to be seen of the different species of the genera *Catopsilia*, *Junonia*, *Precis*, *Neptis*, *Pandita*, Danaides of the *Archippus* type, not a few of the Lycænidæ (*L. bœtica* in particular rejoices in all the sun it can get), and others.

Fam. **Nymphalidæ.**

Subfam. *Danainæ.*

Group Danaina.

1. *Hestia lynceus.*

Papilio lynceus, Drury, Ill. Ex. Ent. ii. t. vii. fig. 1 (1773).

Common in many places; usually seen where the forest has been partially opened.

2. *Hestia hypermnestra.*

Hestia hypermnestra, Westwood, Cab. Orient. Entomol. p. 75, t. xxxvii. fig. 1 (1848).

3. *Hestia leuconoë.*

Idea leuconoë, Erichson, Nova Acta Ac. Nat. Cur. xvi. p. 283 (1834).

The local form of this species has been named (not yet published) *Nectaria labuana* by Mr. Moore.

Abundant; may be seen anywhere, but prefers the edge of mangrove-swamps and similar places, where the water is brackish. The highly gilded pupa was once found by Mr. Pryer attached to a coarse prickly plant in such a locality.

4. *Ideopsis daos.*

Idea daos, Boisduval, Spec. Gén. Lép. i. t. xxiv. fig. 3 (1836).

Not common, under partial forest shade.

5. *Radena vulgaris.*

Danais vulgaris, Butler, Ent. Month. Mag. xi. p. 164 (1874).

Abundant nearly everywhere—near the edge of the forest, in partly overgrown clearings, and similar localities. Has a habit of settling on dead twigs and hanging with its wings folded downwards.

6. *Radena juventa.*

Papilio juventa, Cramer, Pap. Ex. ii. t. clxxxviii. B (1779).

Local, but abundant where found.

7. *Danais aspasia.*

Papilio aspasia, Fabricius, Mant. Ins. ii. p. 15. n. 145 (1787).

Occurs sparingly in forest-paths and overgrown clearings.

Danais aspasia, var. *crocea.*

Danais crocea, Butler, Proc. Zool. Soc. 1866, p. 57. n. 53, t. iv. fig. 5.

Similar localities to the last, with which it is caught flying, which hardly seems to point to its being a seasonal variety.

8. *Danais larissa.*

Danais larissa, Felder, Nov. Reise, Lep. ii. p. 349 (1865).

9. *Danais eryx.*

Papilio eryx, Fabricius, Ent. Syst. Suppl. p. 423 (1789).

Abundant; same localities and habits as *Radena vulgaris.*

10. *Danais septentrionis.*

Danais septentrionis, Butler, Ent. Month. Mag. xi. p. 163 (1874).

At the edge of forest, not common.

11. *Danais lotis.*

Papilio lotis, Cramer, Pap. Ex. iii. t. ccxxx. D, E (1780).

Open weedy places, near forest.

12 *Euplœa Bremeri*, var. *Pryeri.*

Euplœa Bremeri, Felder, Wien. ent. Mon. iv. p. 398. n. 16 (1860).
Tronga Pryeri, Moore, Proc. Zool. Soc. 1883, p. 269. n. 11.

13. *Euplœa Moorei.*

Euplœa Moorei, Butler, Proc. Zool. Soc. 1866, p. 277.

14. *Euplœa Scudderi.*

Crastia Scudderi, Butler, Journ. Linn. Soc., Zool. xiv. p. 297 (1878).

15. *Euplœa Castelnaui*, var. *Godmani.*

Euplœa Castelnaui, Felder, Reise Nov. Lep. ii. p. 315. n. 427 (1865).
Euplœa Godmani, Moore, Proc. Zool. Soc. 1883, p. 291. n. 7.

16. *Euplœa Ménétriési.*

Euplœa Ménétriésii, Felder, Wien. ent. Mon. iv. p. 398. n. 15 (1860).

The habits of most of the *Euplœæ* are very similar; they like the slight shade of partly regrown jungle, forest-paths, and weedy places near the edge of the forest—places, in fact, where there is neither too much nor too little sun. I once saw an immense flight of a species of *Euplœa*; for days they came flying over the Bay of Sandakan from south to north; there were always from four or five to twenty to be seen at once, flying along in the full sunshine as fast as they could, and not flitting backwards and forwards in partial shade, as is their usual custom.

17. *Euplœa mulciber.*

Papilio mulciber, Cramer, Pap. Exot. ii. t. cxxvii. C, D (1799).

Common nearly everywhere—overgrown scrub stuff, edges of forest, forest-paths on nearly open ground.

18. *Euplœa mazares*, var. *aristotelis.*

Euplœa mazares, Moore, Cat. Lep. Mus. E. I. Co. i. p. 128 (1857).
Calliplœa aristotelis, Moore (Horsf. & Moore), Proc. Zool. Soc. 1883, p. 292. n. 3.

19. *Euplœa Lowei.*

Salpinx Lowei, Butler, Journ. Linn. Soc., Zool. xiv. p. 294 (1878).

Common; usually seen below native houses (which are built on piles).

Subfam. SATYRINÆ.

20. *Melanitis leda.*

Papilio leda, Linnæus, Syst. Nat. i. 2, p. 773. n. 151 (1767).
Papilio ismene, Cramer, Pap. Ex. i. t. xxvi. A, B (1775).

Abundant; rarely flies in the daytime unless it is disturbed, when it has a way of settling on the ground, or a dead leaf, or some similar substance, from which it is not easily discernible. For barely an hour or so about sundown it flies at the edge of the forest, four or five together.

Mr. de Nicéville has recently stated that these two generally considered distinct species, *M. leda* and *M. ismene*, are but the wet- and dry-season forms of one species; and this seems borne out by Mr. Pryer's experience, who placed them together in his collection as varietal forms.

21. *Erites argentina.*

Erites argentina, Butler, Cat. Sat. Brit. Mus. p. 188. n. 5 (1868).

One of the few butterflies that frequent forests; but even

in this case it is not high, big-tree forest, but only places where a dry sandy soil supports small trees. It is local and uncommon.

22. *Mycalesis anapita.*

Mycalesis anapita, Moore (Horsf. & Moore), Cat. Lep. Mus. E. I. Co. vol. i. p. 232. n. 495 (1857).

23. *Mycalesis orseis.*

Mycalesis orseis, Hewitson, Exot. Butt. iii. p. 89, *Myc.* t. vi. figs. 36, 37 (1864).

24. *Mycalesis medus.*

Papilio medus, Fabricius, Syst. Ent. p. 488. n. 198 (1775).

25. *Mycalesis mineus.*

Papilio mineus, Linnæus, Syst. Nat. i. 2, p. 768. n. 126 (1767).

26. *Mycalesis fusca.*

Dasyomma fuscum, Felder, Wien. ent. Mon. iv. p. 401. n. 27 (1860).

27. *Ypthima pandocus.*

Ypthima pandocus, Moore (Horsf. & Moore), Cat. Lep. Mus. E. I. Co. vol. i. p. 235. n. 506 (1857).

28. *Ypthima fasciata.*

Ypthima fasciata, Hewitson, Trans. Ent. Soc. ser. 3, vol. ii. p. 287. n. 12 (1865).

Mycalesis and *Ypthima* have very similar habits, frequenting low bushes and long grass everywhere, round the edge of the forest particularly, and rarely rising many feet above the ground.

29. *Ragadia erisia.*

Euptychia erisia, Hübner, Zutr. ex. Schmett. figs. 675, 676 (1832).

Rare, under almost thick-forest shade.

30. *Neorina Lowii.*

Cyllo Lowii, Doubleday & Hewitson, Gen. Diurn. Lep. p. 369, t. lxi. fig. 4 (1851).

Rare, under almost thick-forest shade.

31. *Elymnias nigrescens.*

Elymnias nigrescens, Butler, Proc. Zool. Soc. 1871, p. 520. n. 2, t. xlii. fig. 1.

32. *Elymnias lutescens.*

Elymnias lutescens, Butler, Ann. & Mag. Nat. Hist. ser. 3, vol. xx. p. 404, t. ix. fig. 10 (1867).

Uncommon; open ground near forest.

33. *Elymnias esaka.*

Melanitis esaka, Westwood, Gen. Diurn. Lep. p. 405. n. 10, note (1851).

In fairly open ground, in sunshine.

34. *Elymnias lais.*

Papilio lais, Cramer, Pap. Ex. ii. t. cxiv. A, B (1779).

Rare; habits similar to those of *E. lutescens*.

35. *Elymnias penanga.*

Melanitis penanga, Westwood, Gen. Diurn. Lep. p. 405. n. 9, note (1851).

36. *Elymnias dara*, n. sp.

Female. Wings above chocolate-brown: anterior wings with an oblique, slightly curved, greyish-white fascia, commencing at costa a little beyond end of cell and terminating near outer angle; the costal margin between this fascia and base of wing is speckled with greyish: posterior wings crossed at about centre by a greyish-white fascia, which is narrowed and curved near costa, and is outwardly margined by some small dark spots, which become subobsolete above the upper median nervule; outer margin of both wings strongly scalloped. Wings beneath much paler than above: anterior wings with the white fascia fused in a broad, outer, marginal, greyish-white fascia, which is reticulated with chocolate-brown: posterior wings with a bluish-grey spot, margined with black between the bases of the subcostal nervules, the spots on the outer margin of the greyish-white fascia more continuous and with small bluish centres; beyond the central fascia the ground-colour is greyish, reticulated with chocolate-brown. Body above brownish, beneath with the thorax and legs brownish; the abdomen obscure ochraceous.

Exp. wings 52 millim. (*coll. Dist.*).

37. *Elymnias Godferyi.*

Elymnias Godferyi, Distant, Ann. & Mag. Nat. Hist. ser. 5, vol. xii. p. 351 (1883)

Larvæ feeds on an orchid. A specimen of this orchid hanging in the verandah attracted two or three females, and

a caterpillar feeding on the orchid was bred up and produced the male. This butterfly may be described as rare, but is probably common enough 150 feet above ground amongst the tree-tops, where only the orchid grows. This is another instance of an insect being apparently rare, while, if looked for in the proper place, it would probably be taken commonly enough.

Subfam. *Nymphalinæ.*

Group Morphina.

38. *Amathusia phidippus.*

Papilio phidippus, Linnæus, Syst. Nat. i. 2, p. 752. n. 37 (1767).

Not very common.

39. *Amathusia ottomana.*

Amathusia ottomana, Butler, Ent. Month. Mag. vi. p. 55 (1869).

This and the preceding species are generally seen towards the evening, flying under a half-shade; have habits of settling on tree-trunks.

40. *Discophora cheops.*

Discophora cheops, Felder, Reise Nov. Lep. iii. p. 463. n. 783 (1866).

41. *Thaumantis lucipor.*

Thaumantis lucipor, Westwood, Gen. Diurn. Lep. p. 337. n. 5, note (1851).

Not common.

42. *Thaumantis noureddin.*

Thaumantis noureddin, Westwood, Gen. Diurn. Lep. p. 337. n. 6, note (1851).

Abundant under fairly thick-forest shade.

43. *Clerome gracilis.*

Clerome gracilis, Butler, Ann. & Mag. Nat. Hist. ser. 3, vol. xx. p. 401, t. viii. fig. 7 (1867).

Fairly common; thick-forest shade.

44. *Xanthotænia busiris.*

Clerome (Xanthotænia) busiris, Westwood, Trans. Ent. Soc. ser. 2, vol. iv. p. 187. n. 6 (1858).

Uncommon; thick-forest shade. This and the preceding species are the only two I know that frequent only the shade of the high forest.

Group Nymphalina.

45. *Doleschallia polibete.*

Papilio polibete, Cramer, Pap. Ex. iii. t. ccxxxiv. D, E (1782).

Not common.

46. *Precis ida.*

Papilio ida, Cramer, Pap. Ex. i. t. xlii. C, D. (1776); *ibid.* iv. t. ccclxxiv. C, D (1782).

47. *Junonia atlites.*

Papilio atlites, Linnæus, Cent. Ins. p. 74. n. 72 (Amœn. vi. p. 407) (1763).

48. *Junonia Wallacei.*

Junonia Wallacei, Distant, Rhop. Malay. p. 25. n. 3 (1883).

Precis and *Junonia* are found in open ground in hot sunshine.

49. *Kallima Buxtoni.*

Kallima Buxtoni, Moore, Trans. Ent. Soc. 1879, p. 10.

50. *Charaxes delphis.*

Charaxes delphis, Doubleday, Ann. Soc. Ent. France, 1843, p. 217, t. vii.

Observed drinking at a pool of water.

51. *Charaxes harpax.*

Charaxes harpax, Felder, Reise Nov. Lep. iii. p. 444. n. 725 (1866).

52. *Symphædra dirtea.*

Papilio dirtea, Fabricius, Ent. Syst. iii. 1, p. 59. n. 184 (1793).

Abundant. Forest-paths, where the tree-tops have closed overhead, or other somewhat open places in the forest; chewed sugar-cane left in such a place attracts it by dozens.

53. *Symphædra canescens.*

Symphædra canescens, Butler, Proc. Zool. Soc. 1868, p. 612. n. 2, t. xlv. fig. 5.

Not common.

54. *Euthalia derma.*

Adolias derma, Kollar, Hüg. Kaschm. iv. 2, p. 436 (1848).

Edges of forest and similar localities; not common.

55. *Euthalia dunya.*

Adolias dunya, Doubl. & Hew. Gen. Diurn. Lep. t. xliv. fig. 3 (1850).

One only, caught at rest on a tree-trunk.

56. *Euthalia anosia.*

Adolias anosia, Moore (Horsf. & Moore), Cat. Lep. Mus. E. I. Co. i. p. 187. n. 376 (1857).

In one place only, at the back of Elopura, flying in open sunshine in some regrown scrub-stuff.

57. *Euthalia garuda.*

Adolias garuda, Moore (Horsf. & Moore), Cat. Lep. Mus. E. I. Co. i. p. 186. n. 374 (1857).

Not often seen flying, but larva only too abundant on mango-trees.

58. *Euthalia ambalika.*

Adolias ambalika, Moore (Horsf. & Moore), Cat. Lep. Mus. E. I. Co. i. p. 192. n. 386 (1857).

59. *Euthalia decorata.*

Adolias decoratus, Butler, Proc. Zool. Soc. 1868, p. 605. n. 39, t. xlv. fig. 209.

60. *Euthalia bellata.*

Adolias bellata, Druce, Proc. Zool. Soc. 1873, p. 344. n. 3, t. xxxii. fig. 3.

61. *Euthalia lubentina.*

Papilio lubentina, Cramer, Pap. Ex. ii. t. clv. C, D (1779).

62. *Euthalia djata*, n. sp.

Allied to *E. lubentina*, Cram., but differing in the following particulars:—The male is smaller and darker, the anterior wings above are entirely without the red spots in cell and the white spots on apical portion of wing; beneath the anterior wings possess the red spots, but are totally without the white ones; the posterior wings beneath have the red costal streak confined to base, and the red submarginal spots obsolete towards anal angle. The female resembles the corresponding sex of *E. lubentina*, but the posterior wings both above and beneath are totally without the inner series of red-and-black bordered spots, and above are traversed by two waved discal black lines.

Exp. wings: ♂, 50 millim.; ♀, 60 millim.

63. *Tanaëcia lutala.*

Adolias lutala, Moore, Trans. Ent. Soc. ser. 2, vol. v. p. 71. n. 17, t. vi. fig. 3 (1859).

64. *Tanaëcia clathrata.*

Adolias clathrata, Vollenhoven, Tijd. Ent. v. p. 205. n 38, t. xii. fig. 5 (1862).

The females are rather general in their occurrence, but more

common in forest-paths than elsewhere. The pretty black males with their blue-edged wings frequent spots in the forest where the sun happens to penetrate, seating themselves on the leaves with the wings wide-spread.

65. *Euripus borneensis*, n. sp.

This species or local race bears about the same relationship to *E. halitherses* as *Euplœa Lowii* does to *E. rhadamanthus*, and is therefore remarkable for its melanic hue.

Male. Scarcely differing from the corresponding sex of *E. halitherses* and *E. euplœoides*.

Female. Dark chocolate-brown above with all the white markings (as in the other two species) much abbreviated, especially on the posterior wings, where the usual whitish basal area is reduced to a few whitish basal streaks.

Exp. wings: ♂, 60 millim.; ♀, 75 millim.

Common; the male is the rover in this case, the female being confined to one or two places in the vicinity of Elopura.

66. *Euripus cinnamomeus.*

Euripus cinnamomeus, Wood-Mason, J. A. S. Beng. vol. l. p. 272, t. iv. fig. 4 (1881).

This species was described from a specimen captured in the Khasi Hills, N.E. India.

67. *Cyrestis nivea*, var. *nivalis.*

Amathusia nivea, Zinken-Sommer, Nova Acta Ac. Nat.-Cur. xvi. p. 138, t. xiv. fig. 1 (1831).
Cyrestis nivalis, Feld. Reise Nov. Lep. iii. p. 414. n. 634 (1866).

68. *Chersonesia rahria.*

Cyrestis rahria, Moore (Horsf. & Moore), Cat. Lep. Mus. E. I. Co. vol. i. p. 147. n. 301, t. iii. *a*. fig. 2 (1857).

Edge of forest &c.

69. *Parthenos gambrisius.*

Papilio gambrisius, Fabricius, Ent. Syst. iii. 1, p. 85. n. 264 (1793).

Abundant everywhere.

70. *Lebadea paduka.*

Limenitis paduka, Moore (Horsf. & Moore), Cat. Lep. Mus. E. I. Co. vol. i. p. 179. n. 365 (1857).

Common; forest-paths and similar places.

71. *Pandita sinoria.*

Pandita sinoria, Felder, Reise Nov. Lep. iii. p. 425. n. 670 (1866).

Abundant; fond of the hottest sunshine.

72. *Limenitis procris.*

Papilio procris, Cramer, Pap. Ex. ii. t. cvi. E, F (1779).

Common; edges of the forest.

73. *Neptis paraka.*

Neptis paraka, Butler, Trans. Linn. Soc. ser. 2, Zool. vol. i. p. 542. n. 9 t. lxviii. fig. 2 (1877).

74. *Neptis vikasi.*

Neptis vikasi, Horsfield, Cat. Lep. Mus. E. I. Co. t. v. figs. 2, 2*a* (1829).

75. *Neptis durgodana.*

Neptis durgodana, Moore, Proc. Zool. Soc. 1858, p. 10. n. 21, t. xlix. fig. 8.

76. *Neptis eurynome*, var.

Neptis eurynome, Westwood, Don. Ins. China, p. 66, t. xxxv. fig. 4 (1842).

77. *Athyma kresna.*

Athyma kresna, Moore, Proc. Zool. Soc. 1858, p. 12. n. 6, t. l. fig. 4.

78. *Athyma nefte* var.

Papilio nefte, Cramer, Pap. Exot. iii. t. cclvi. E, F (1782).

79. *Athyma larymna.*

Limenitis larymna, Doubleday & Hewitson, Gen. Diurn. Lep. t. xxxv. fig. 1 (1850).

80. *Athyma pravara.*

Athyma pravara, Moore (Horsf. & Moore), Cat. Lep. Mus. E. I. Co. i. p. 173. n. 354, t. v. *a.* fig. 4 (1857).

81. *Athyma kanwa.*

Athyma kanwa, Moore, Proc. Zool. Soc. 1858, p. 17. n. 17, t. li. fig. 2.

82. *Athyma subrata.*

Athyma subrata, Moore, Proc. Zool. Soc. 1858, p. 13. n. 10, t. li. fig. 1.

Neptis and *Athyma* frequent open spaces not necessarily near the forest, and rejoice in the hottest sun. *Neptis* floats along with open wings only some 3 feet above the ground; *Athyma* usually has a bolder flight.

83. *Hypolimnas incommoda.*

Hypolimnas incommoda, Butler, Trans. Linn. Soc. ser. 2, Zool. vol. p. 543. n. 2 (1877).

84. *Hypolimnas alcithoë.*

Papilio alcithoë, Cramer, Pap. Ex. i. t. lxxx. A, B (1779).

85. *Hypolimnas misippus.*

Papilio misippus, Linnæus, Syst. Nat. ed. 12, p. 767. n. 118 (1758).

86. *Hypolimnas anomala.*

Diadema anomala, Wallace, Trans. Ent. Soc. 1869, p. 285. n. 15.

The species of *Hypolimnas* frequent sunny places, not necessarily near the forest. Sometimes individual specimens of *H. incommoda* and *H. alcithoë* haunt the same bush for days together. The manner of flight and habits of *H. misippus* are different from those of the other species of the genus.

87. *Cethosia hypsea.*

Cethosia hypsea, Doubleday & Hewitson, Gen. Diurn. Lep. t. xx. fig. 4 (1847).

Common; open places in the forest.

88. *Cupha erymanthis.*

Papilio erymanthis, Drury, Ill. Ex. Ent. i. t. xv. figs. 3, 4 (1773).

Abundant.

89. *Cirrochroa satellita.*

Cirrochroa satellita, Butler, Cist. Ent. i. p. 9 (1869).

90. *Cirrochroa bajadeta.*

Cirrochroa bajadeta, Moore (Horsf. & Moore), Cat. Lep. Mus. E. I. Co. i. p. 150. n. 309, t. iii. *a.* fig. 3 (1857).

Abundant; forest-paths in the sunshine.

91. *Cirrochroa calypso.*

Cirrochroa calypso, Wallace, Trans. Ent. Soc. 1869, p. 339.

92. *Paduca fasciata.*

Atella fasciata, Felder, Wien. ent. Mon. iv. p. 236. n. 83 (1860).

93. *Terinos clarissa.*

Terinos clarissa, Boisduval, Sp. Gén. i. t. ix. fig. 4 (1836).

Not common; forest-paths and edges.

94. *Cynthia deione.*

Cynthia deione, Erichson, Nova Acta Ac. Nat.-Cur. xvi. suppl. p. (279) p. 403. n. 3, t. l. figs. 2, 2 *a* (1833).

Common; forest-paths.

V.—*On some Darwinistic Heresies.* By Prof. CARL VOGT *.

M. VOGT would not like it to be thought that he does not fully accept the theories of descent, of transformism, and of natural selection—in fact, all the fundamental points upon which Darwinism is based; he only desires to combat certain exaggerations, ill-founded applications, and hazardous conclusions which have been derived from it, and of which it has been attempted to make irrefutable dogmas. To commence with the final thesis to the demonstration of which the speaker desired to apply himself, he says :—" Our present zoological classification cannot be, and is not, what is everywhere said, the expression of actual relationship existing between the different members of a class, order, family, or even genus—a relationship the demonstration of which would be based upon phylogenetic and ontogenetic development,—but, at any rate in many cases, the result of a combination of similar characters which we find in creatures originating from different stocks."

Let us establish, in the first place, some elementary principles.

We generalize far too much when we raise to the rank of a general law conclusions drawn from observations made upon special cases.

Consciously or unconsciously we start from the idea that Nature sets before her a purpose to be attained in accordance with a plan formed in advance, as we do in the case of our own actions, and that she arrives at this end by following the most direct course.

Now it is precisely the contrary that is true. Every natural phenomenon is complex, and can be only the result of a multitude of varied forces, often even opposed to each other. In most cases, therefore, Nature arrives at a certain result or phenomenon only by the most indirect ways. If this were not the case we should no longer have to make experiments; for the art of experimentation consists in the elimination of sources of error, that is to say of opposing influences, which prevent our arriving at a simple result produced by an isolated and circumscribed cause.

To take an example :—Among the Mammalia there is not apparently a more uniform group than the horses or Solipedes. It is only upon differences of the coat, having no influence

* Translated from the Abstract in the 'Bibliothèque Universelle: Archives des Sciences physiques et naturelles,' October 15, 1886, tome xvi. pp. 330–338.

upon the other characters, that the African horses, the zebras, have been distinguished, under the name of *Hippotigris*, from the other horses. Now-a-days we have indigenous Solipedes only in the Old World: those of America have been introduced from Europe at a comparatively very recent historical date; but in the Quaternary epoch herds of indigenous horses traversed the plains of America as they traversed those of the Old World.

We now know the phylogeny of the American Solipedes better than that of the Solipedes of the Old World; we know how the feet and the teeth have been gradually transformed from Eocene to Quaternary times, when the genus *Equus* existed on both sides of the Atlantic Ocean.

Now this genus, which is so uniform, originates from two very different stocks; *it is of diphyletic origin.*

By arranging parallel to one another the lines of descent formed by the genera indicated by palæontologists in America and Europe, and placing the genera opposite each other in the order of the strata, we find, in fact, that we cannot identify any of the genera living on this side of the water during the Eocene, Oligocene, and Miocene epochs with the genera living in America at the same epochs. The *Lophiotheria*, *Palæotheria*, *Anchitheria*, and *Hippariones* of the Old World are different from the *Eohippi*, *Orohippi*, *Epihippi*, and *Anchippi* which mark the same epochs in the New World; and it is a remarkable thing, to which we shall revert, that the differences are the greater as we ascend towards the supposed stocks in the older Tertiary strata. It is only in the Pliocene and Quaternary deposits that we find on both sides of the ocean the identical genera *Hippotherium*, *Protohippus*, and finally *Equus*, the definitive term.

Let us bring these facts together a little in order to draw the conclusions which flow from them. The ancestors of the horses of one side of the ocean were unable to generate descendants on the other shore; there was therefore an insurmountable obstacle, the sea; the two continents must have been separated at least from the Eocene epoch. This conclusion is confirmed by the study of the other series of descent of terrestrial Mammalia with which we are more or less acquainted—the pigs, the ruminants, the camels, and the rhinoceroses of the Old World originate from stocks and pass through genetic stages different from those of the corresponding series of the new continent.

Geological geography, that is to say the delimitation of the ancient continents and seas at different geological epochs as taught to us by geology, must therefore occupy an important

place in phylogenetic speculations, and *any phylogenetic tree which does not take it into account is by that fact alone erroneous or null.*

The above-mentioned facts lead us, in the second place, to conclude that there is *convergence of characters.* As early as 1874, at the meeting at the French Association at Lille, Prof. Vogt brought forward a thesis suggested by the investigation of various parasites (*Entoconcha, Sacculina, Redia*), and formulated in the following terms :—"Prolonged adaptation to a restricted but predominant cause gradually effaces the divergent characters of types and finally effects, if not their union, at least their approximation to such a degree that the distinctive characters even of the great divisions of the animal kingdom become entirely unrecognizable."

There is reason to widen this proposition. Do we not see this convergence take place in a number of series of animals living in perfect freedom? The more we study animals, even those the phylogeny of which we cannot know, the more we come to facts which lead to conclusions establishing a multiple origin for the groups which are united in our classification. Has not Prof. Häckel, the monophyletist *par excellence*, been led by his investigations upon the Medusæ to ascribe to them a diphyletic origin?

We see this convergence manifested not only in entire groups, but also in organs. Starting from the limbs of the Chelonians and seals we see set up series of modifications leading to the paddles of the Halisaurians, Cetacea, and Sirenia. Have not these last two orders, differing completely in their dentition and other anatomical characters, indicating very different stocks, been brought together solely because their limbs are constructed in the same fashion?

If, then, convergence is established in many instances, it is our business to examine how it is brought about. So far as we know from palæontological and embryonic investigations, all metamorphoses take place in three different ways :—

1. By the reduction and final loss of primordial characters.
2. By the excessive and unilateral development (*einseitige Entwicklung*) of other characters which often originally existed only roughly sketched out.
3. By changes of function (*Functionswechsel*), which are so frequent, and to which M. Dohrn long since called the attention of naturalists, without finding much response. Change of functions also implies the separation of parts originally united, and the fusion of other parts originally separated.

Prof. Vogt cannot enter into the details which prove these assertions; but, if they are true, it necessarily follows from

them that there is not and cannot be harmonious development in any organism, it being of course understood that a harmonious creature must have all the organs and systems of organs brought to the same level of perfection. There can only be relative harmonies, in this sense, that one or several organs become preponderantly developed, and that the others adapt themselves in such a manner as not to impede but to sustain the functions of these preponderant organs.

Man himself is a proof of what we advance. In him everything is subordinated to the development of the brain. From almost all other points of view he is a retrograde organism, of which the organs, taken separately, are often very inferior to those of other animals. The limbs have retained the ancient pentadactyle type. The eye itself, the superiority of which has been so much vaunted, is in certain respects very defective.

But we arrive at yet other conclusions. If the ulterior development takes place by one of the three courses above indicated, or by their combination, it follows that the possibility of tracing one or the other of these courses must originally exist—in other words, the organs or the rudiments of the organs subject to development and transformation must exist in the anterior conditions either in the embryos or in the ancestors.

From what precedes some consequences result fatal to several dogmas almost universally accepted. There has been established a so-called biogenetic law, according to which the ontogeny and the phylogeny must correspond exactly. The embryos must pass compendiously through the same phases which the stock has passed through during the geological epochs.

From what we have said of relative harmonies it follows that this law is absolutely false in its foundation, and a careful investigation of embryogeny in fact shows that the embryos have relative harmonies of their own quite different from those of the adults. The embryo of a mammal has a chorda dorsalis and branchial clefts analogous to those of a fish or of one of the lower Amphibia. Can there have been an ancestor organized in the same fashion? Never! for such a creature could not have lived, having neither intestine, nor locomotive organs, nor brain, nor organs of sense fitted to perform their functions, which, however, are necessary for free and independent existence.

To explain these contradictions the word *cœnogeny*, falsified embrogeny, has been invented. Poor logic, how it is tortured! Nature falsifying herself!

Let us go on. If the ways indicated as those by which the transformations are effected be true, it follows that we can by no means deduce complicated organisms from simple ones which have not even the rudiments of the organs with which the former are furnished. Neither in palæontology nor in embryogeny have we facts which can demonstrate the acquisition of entirely new organs, while; on the contrary, there are facts in abundance which prove that the ulterior development is effected, as we have stated, by losses (limbs, dentition), or by excessive development of existing rudiments, or by change of function.

If we apply these facts to our phylogenetic speculations we must recognize that the latter must be completely reversed, that the less complicated animals owe their existence to a more or less complete retrogradation, and that they must constitute the final terms and not the foundations of phylogenetic series. In one word, all our genealogical trees at present accepted must be revised from base to apex so far as they do not correspond with the principles enunciated.

It is to be remarked that these views square very well with palæontological facts. We have tortured our minds to explain the presence in the most ancient formations of highly organized types and of what have been in part called collective types, presenting characters oscillating between those of classes and orders now well marked. Cephalopods, Trilobites, Ganoids, and Dipnoids swarm in the ancient formations, and yet these animals belong to the highest types of their respective divisions. They have constituted the stocks of the types which have succeeded them, and their descendants have been formed by the unilateral development of certain organs or rudiments, combined with the retrogradation or the loss of other organs which the stock originally possessed.

Let us return, in conclusion to our starting-point. The phylogenetic development of the different types has been presented to us in the form of trees which branch as they ascend. Accepting this image, we may say that with regard to these trees our classification plays the part of an espalier to the interspaces of which our divisions into subkingdoms, classes, orders, &c. correspond. The branches of the trees to the right and left which arrive in a compartment thus bounded are definitely classed there, although starting from different stocks.

VI.—*Descriptions of nine new Species of African Butterflies.* By H. Grose Smith.

Pieris gallenga.

Male.—Upperside. Both wings pale orange-yellow; anterior wings with the costa and apex narrowly pale brown.

Underside. Anterior wings pale orange-yellow, with the costa and apex orange-brown; posterior wings orange-brown.

Near to *P. Spilleri*, but differs in colour, is smaller, and the anterior wings are more rounded.

Expanse $1\frac{3}{8}$ inch.

Hab. Delagoa Bay (*Mrs. Monteiro*).

In the collection of H. Grose Smith.

Acræa machequena.

Male.—Upperside. Anterior wings transparent, clouded with brown from the base to the end of the cell, and below it to the inner angle; posterior wings brown, a row of seven lunular black spots on the margin; beneath each lunule is a small brown spot on the margin; from the centre of the costal margin to the centre of the hind margin is an irregular row of eight distinct small black spots, within which is a cluster of six spots near the base, also distinct.

Underside. As above, but paler.

Female closely resembles *manandaza* of Ward, while the male is very close to *ranavalona* of Boisduval. The male and female having been taken *in copulâ*, it would appear clear that *manandaza* and *ranavalona* are also sexes of the same species. *Machequena* differs from them in the colour of the male and in size of the spots on the posterior wings, which are smaller and distinct, not confluent as in *ranavalona*, and the marginal row of spots is nearer the margin. I am not aware that *ranavalona* or *manandaza* have been taken on the mainland.

Expanse 2 inches.

Hab. Delagoa Bay (*Mrs. Monteiro*).

In the collection of H. Grose Smith.

Acræa salambo.

Upperside. Semitransparent, greyish brown, the inner portion in which the spots are placed much lighter and tinged

with pink. Anterior wings with a large black spot in the middle of the cell, another at the end of the cell, beyond which, near it, is a third spot; trifid, beneath these are six spots, the three outermost in a curved band between the median nervures, the lowest being bifid. Posterior wings with the outer margins broadly dark brown, inside which is a curved band of eight black spots, and irregularly clustered towards the base is a group of twelve black spots.

Underside. As above, but lighter; the posterior wings darker towards the margins, but without the broad dark brown margin, tinged with pink towards the base. Abdomen black, the end segments yellowish brown. Antennæ black.

Expanse $3\frac{1}{2}$ inches.

Hab. Congo.

In the collection of H. Grose Smith.

Euryphene elpinice, Hewitson.

Male.—Upperside. Brown. Anterior wings with the costa, apex, and exterior margin broadly dark brown, a small spot in the cell near the base, another in the middle shaped like the figure 8, another at the end of the cell; a series of irregular indistinct brown markings from beyond the centre of the costa to the inner angle, confluent towards the costa; a yellowish-brown spot near the apex. Posterior wings: costa broadly brown, exterior margin and anal angle brown, a figure-of-8 spot in the cell and an indistinct submarginal band of brown linear spots.

Underside. Anterior wings dark purplish brown, light pinkish-brown in the cell between the spots, of which there are three, one small, near the base, a figure-of-8 spot in the middle, a smaller spot at the end of the cell, beyond which is a pink spot, and another at the apex; a submarginal row of brown spots. Posterior wings pale purplish brown, a figure-of-8 spot in the cell, and an irregular band of dark purplish brown before the middle; a submarginal row of brown linear spots.

Expanse $2\frac{1}{8}$ inches.

Hab. Camaroons.

Resembles "*plautilla*" in shape, but the wings are more scalloped.

In the collection of H. Grose Smith.

Harma herminia.

Male.—Upperside. Both wings light tawny brown, brighter towards the exterior margins, crossed beyond the middle by a broad dark brown band; on the anterior wings the band

tapers towards the apex and is broader towards the inner margin, sinuated slightly internally and deeply so externally; on the posterior wings the band is broader on the costal margin and tapers towards the anal ângle; between the band and margins on both wings is an irregular row of brown hastate markings; the base of the anterior and the base and fold of the posterior wings broadly brown, as well as the exterior margins of both wings.

Underside. Both wings light tawny brown, the band less distinct, bordered internally by a brown line extending from the costa of the anterior wing to the anal angle, inside which are the usual markings, the spots in the middle and at the end of the cell on the anterior wing brown, both wings with a submarginal band of indistinct hastate spots. Nearest to *cœnis* and *capella*.

Hab. Camaroon Mountains.

Expanse $2\frac{3}{4}$ inches.

In the collection of H. Grose Smith.

Harma haimodia.

Female.—Upperside. Both wings light rufous from the base to beyond the middle. Anterior wings with the apical portion from the centre of the costa to the inner angle brown-black, crossed by an oblique band of six white spots, the third being small, the fourth the largest, elongated, with a small black spot in the middle, the fifth spot interrupted, and the sixth near the inner angle nearly obsolete, two white spots near the apex. Posterior wings from beyond the middle brown-black, with a submarginal irregular band of white spots, those towards the apex indistinct and smaller than the three nearest the inner angle.

Underside. Rufous-orange, darker towards the apex. Anterior wings with two indistinct red spots in the cell, the band of spots and two apical spots as on the upperside and apex white; a submarginal row of dull brown hastate markings. Posterior wings with the submarginal row of white spots bordered inwardly with dull brown, inside which is an indistinct row of hastate white markings, an indistinct white spot near the centre of the costa, a submarginal row of brown linear markings edged outwardly with white. Margins of both wings crenulated. Thorax and abdomen rufous.

Expanse $2\frac{1}{4}$ inches.

Hab. Camaroons.

In the collection of H. Grose Smith.

Deudorix dinochares.

Male.—Upperside. Copper-red. Anterior wings with costal

margin, apex, and exterior margin to the inner angle broadly dark brown. Posterior wings with one tail; the lobe grey with an orange spot; a smooth brown spot near the base on the costal margin.

Underside. Grey tinged with orange. Anterior wings with a spot at the end of the cell, and a submarginal band formed by reddish-brown lines edged with white, an indistinct grey line between the band and the exterior margin; the lower part of the wing towards the interior margin paler, a tuft of brown hairs midway on the interior margin. Posterior wings with three red spots near the base, that nearest the inner margin nearly obsolete, and a series of red lines bordered with white forming the usual bands; the caudal spot black crowned with yellow, lobe black.

Female.—Upperside. Dull blue, shading broadly into brown on the costal and exterior margins, paler in the middle of the anterior wings. Posterior wings with a black caudal spot, lobe grey.

Underside. Grey with red markings as in the male.

Expanse $1\frac{1}{4}$ inch.

Hab. Delagoa Bay (*Mrs. Monteiro*).

In the collection of H. Grose Smith.

Deudorix dinomenes.

Male.—Upperside. Copper-red, paler than in *dinochares* and more glossy. Anterior wings with a brown apex.

Underside. Anterior wings darker and redder than in *dinochares*, the lower portion down to the inner margin orange. Posterior wings with three basal spots larger than in *dinochares* and the lines forming the bands on both wings broader and redder; the outer portion of the posterior wings from beyond the middle irrorated with white.

Female.—Upperside. Dull blue, more grey than in *dinochares*, in other respects resembling it; but on the posterior wings is a marginal black spot between the caudal spot and the lobe.

Underside. The spots and lines redder and broader than in *dinochares*.

Both the above species approximate to *dariaves* and *diocles* of Hewitson, and in colouring resemble *Polyommatus hippothoë* and its allies.

Expanse $1\frac{1}{4}$ inch.

Hab. Delagoa Bay (*Mrs. Monteiro*).

In the collection of H. Grose Smith.

Lycænesthes mahota.

Upperside. Both wings orange-brown. Anterior wings

with the base, costal margin, the upper part of the cell, and the exterior margin broadly dark brown. Posterior wings with the base, the costal, exterior, and inner margins, two spots near the anal angle, and an interrupted submarginal line dark brown.

Underside. Both wings greyish brown, lighter in the middle, with the orange-colour showing through, crossed with several bands of white and two white submarginal lines Posterior wings with two spots near the anal angle, both irrorated with silver, the spot furthest from the angle bordered on three sides with orange.

Expanse $1\frac{1}{8}$ inch.

Hab. Delagoa Bay (*Mrs. Monteiro*).

In the collection of H. Grose Smith.

VII.—*Diagnosis of a new Species of* Hesperomys *from North America.* By OLDFIELD THOMAS.

Hesperomys (*Vesperimus*) *Taylori*, sp. n.

Allied and very similar in colour to *H. michiganensis*, Aud. & Bachm., but not more than about half the bulk of that species. Centre of back not darker than sides; tail indistinctly bicolor; foot-pads black, five on the fore and six on the hind feet; soles naked nearly to the heel.

Measurements of an adult male (in skin):—Head and body (c.) 53 millim.; tail 32; hind foot, without claws, 13; ear, above crown, 5·0; skull, basal length 15·0, greatest breadth 9·5; nasals, length 6·5; interorbital constriction 3·4; interparietal, length 2·0, breadth 5·0; palate, length 8·4; palatal foramen 3·6; length of molar series 2·7; basicranial axis 5·6.

Hab. San Diego, South Texas (*W. Taylor*).

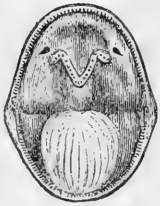
The smallest hitherto-known North-American *Hesperomys*, and the only near ally of *H. Taylori*, is *H. michiganensis*, which has a hind foot ranging in length from 17 to 19 millim. and a skull 20 millim. in basal length.

It is with much pleasure that I connect with this interesting and diminutive animal, the smallest of its genus, the name of its discoverer, Mr. William Taylor, to whom the Natural-History Museum is indebted for many rare Rodents.

VIII.—*Description of a new Tailed Batrachian from Corea.* By G. A. Boulenger.

Hynobius Leechii, sp. n.

Palatine teeth forming a  -shaped figure, which is broader than long; the length of one of the series, from anterior to posterior angle, equals one half of the width of the tongue. Head depressed, a little longer than broad; snout short, rounded. Body thrice and two thirds the length of the head; the distance from snout to gular fold contained nearly thrice in the distance from latter to cloaca. Limbs not meeting when adpressed; fifth toe well developed. Tail nearly as long as the distance between gular fold and vent, thick, compressed, not keeled, with vertical grooves, obtusely pointed posteriorly. Skin smooth; thirteen costal grooves; a vertebral groove. Blackish brown, above speckled with pale brownish; upper surface of tail pale brownish, with a few black dots.



	millim.
Total length	83
From snout to cloaca	47
Head	10
Width of head	8·5
Fore limb	12
Hind limb	14
Tail	36

A single specimen formed part of a small collection of Batrachians made at Gensan, Corea, and presented to the Natural-History Museum by J. H. Leech, Esq. The other species are: *Rana esculenta*, var. *japonica*, *Bufo vulgaris*, and *Hyla arborea*, var. *Savignyi*.

Finding that the name *Anaides*, given by Baird in 1849 to a genus of Plethodontine newts (*cf.* Cat. Batr. Caud. p. 52) is preoccupied (Westwood, 1841), I propose to change it to *Autodax*.

IX.—*On the Genus* Hindia, *Duncan, and the Name of its Typical Species.* By George Jennings Hinde, Ph.D., F.G.S.

Dr. Rauff's* able paper on this genus, a translation of which by Mr. W. S. Dallas appeared in the September number

* "Ueber die Gattung *Hindia*, Dunc.," Sitzungsb. der Niederrh. Gesell. zu Bonn, Sitzung vom 10. Mar. 1886.

of the 'Annals,' has served to clear up many of the doubtful points in the structure of this sponge, which had remained unexplained in the original description * by Prof. Duncan and in my own subsequent short notice † of it. I have recently again studied the characters of the fossil from new and better prepared microscopic sections, and, thanks to the generosity of Dr. Rauff, I have had the opportunity of examining the specimens and sections on which his descriptions were based, as well as the admirable drawings made from them for his forthcoming monograph. Before, however, commenting on Dr. Rauff's observations on the genus, I wish to reply to two objections brought against me by Prof. Duncan, in the September number of the 'Annals,' respecting my notice of *Hindia* in the 'Catalogue of Fossil Sponges in the British Museum,' p. 57.

The first point raised by Prof. Duncan is that I have replaced the name "*sphæroidalis*," given by him to the typical species in 1879, by the name "*fibrosa*," applied by Ferd. Rœmer ‡ to the same species in 1860. Prof. Duncan rightly states, "that a species in order to be established must be so described that other forms than the type can be recognized;" and he further alleges "that there is not a single sentence in the description [Rœmer's], meagre as it is, that would lead any one to distinguish the form I described from New Brunswick as belonging to it;" and "Ferd. Rœmer not having properly and practically described the form he studied, and having placed it among the corals, I [*i. e.* Duncan] do not consider his species of any value whatever."

If these statements of Prof. Duncan represented the whole truth of the matter he would be fully justified in placing the name "*fibrosa*" on one side, and insisting, as he does, that "*Hindia sphæroidalis* is quite correct." But after a careful examination of fossils like those named *Calamopora fibrosa*, Rœm., of which there are several examples in the British Museum, and comparing them with Rœmer's descriptions and figures, I can affirm "that they have been properly and practically described, so that other forms than the type can be recognized;" and though they have been erroneously referred to corals, yet the specific name is not thereby invalidated.

The explanation of this apparent strong contradiction is as follows:—It happens that the forms from Tennessee studied by Rœmer are in the condition of silicified casts, in which the

* Ann. & Mag. Nat. Hist. 1879, ser. 5, vol. iv. p. 84.

† 'Catalogue Fossil Sponges Brit. Mus.' p. 57.

‡ 'Die silurische Fauna d. westl. Tennessee,' p. 20, pls. 2, 2*a*, 2*b*.

original spicular structure of the sponge has almost entirely disappeared, and the radiating canals and interspaces between the spicules are infilled with solid silica. When thus preserved the fossil has a most deceptive resemblance to a minute Favositoid coral which has been silicified, and it is therefore no matter for surprise that even so experienced a palæontologist as Ferd. Rœmer *, who had not seen the form in any other state of preservation, should have regarded it as a coral with minutely perforated walls. His description of the characters of the specimens is clear and explicit, and the accompanying figures accurately represent its external form and internal structure, so that even small fragments of the fossil could be recognized from them. It is not Rœmer's fault if his faithful description of the forms which he named "*fibrosa*" does not correspond with that given later by Duncan of the same fossil in a different state of preservation. A mere cursory glance at Rœmer's figures would lead one to suspect the identity of the silicified forms from Tennessee with the calcified ones from New Brunswick described by Duncan. This identity can be readily demonstrated by placing a specimen from this latter locality in dilute acid, when, by the removal of the spicular structure, it presents the same appearance as the Tennessee examples. In one specimen in my possession the same result has been effected by natural means, so that in one part of it the structures described by Rœmer as "*fibrosa*" are clearly shown, and in another part those which Duncan placed under the specific name "*sphæroidalis*."

Under these circumstances I submit that Rœmer's clear description and figures of these silicified fossils justly entitle his specific name "*fibrosa*" to be retained for them, and that the error he made in placing them as corals does not, according to the recognized rules of scientific nomenclature, warrant its rejection in favour of the subsequent designation of Prof. Duncan. If such a substitution were allowed there would be

* Ferd. Rœmer does not stand alone in making this mistake. The description of this same fossil was the first attempt I myself made at palæontological work, and in complete ignorance that it had been previously noticed by Rœmer I also put it down as a coral! I had the less excuse for the error since my specimens were not silicified. Fortunately the Geological Society, to whom my paper and specimens were sent, only published the former in abstract. The mistake I made taught me to use the microscope and greater caution in future work. It is still more remarkable that even after both I and Ferd. Rœmer had, independently of each other, publicly acknowledged that our supposed coral was a true sponge, Dr. Steinmann, a palæontologist of some pretensions, should boldly declare that the same fossil had not a single characteristic feature of a sponge, and that it ought to be relegated to the same genus of *Favosite*-corals in which Rœmer had originally placed it.

constant shifting of specific names and corresponding confusion. It may be mentioned that the course I have adopted in retaining Rœmer's specific name has also been followed by Dr. Rauff—an independent critic.

Prof. Duncan does not seem to be aware that even if he substantiated his claim to the name he proposed as against that of Rœmer, there is yet another bar to its adoption, since the same species in the interval between Rœmer's and Duncan's work was described by Prof. Hall *, of Albany, under the title of "*Astylospongia inornata.*" The description in this case is indeed very meagre, and, as no figures are given, it might fairly be alleged that it is insufficient for the recognition of the species. That, however, the *A. inornata*, Hall, is the same as *Hindia fibrosa*, Rœmer, I am fairly confident, as I have myself collected from the same strata, in the localities mentioned by Hall, the fossils answering to his descriptions, and they are identical with Rœmer's forms.

The second point raised against me by Prof. Duncan relates to the original mineral nature of the sponges of this genus *Hindia*, which are asserted, in his first description of the form in 1879, to have been calcareous, whilst I have placed them as siliceous in the Cat. Foss. Sponges. Prof. Duncan, in the September number of the 'Annals,' after full consideration of the arguments brought forward by myself and Dr. Rauff for their siliceous nature, again states his belief in their original calcareous constitution, and says that I omitted to notice one of the main arguments in favour of this theory, viz. "the discovery of a penetrating, parasitic, unicellular, vegetable organism within the canals and traversing the spicules"†. The omission on my part was not from a consciousness of the asserted fact having any important bearing on the argument, but simply because I felt that it was founded on errors of observation which, to spare Prof. Duncan, it would be preferable to pass over in silence.

Two reasons were brought forward by Prof. Duncan in 1879 ‡ for the original calcareous nature of *Hindia*: one, that the carbonate of lime, of which the spicular structure of the New Brunswick specimens now consists, was not in distinct crystals, but resembled that of fossils which were originally of this mineral; the other, that "in the midst of the long canals, in their interspaces, and passing over the

* "Note on the Occurrence of *Astylospongia* in the Lower Helderberg Rocks," '16th Annual Report of the State Cabinet of Natural History,' 1863, p. 69.

† 'Annals,' 1886, vol. xviii. p. 228.

‡ 'Annals,' vol. iv. p. 90.

skeletal parts, in close proximity, are many relics of a large form of *Palæachlya** *penetrans*, Duncan, and in sections the passage of the tubes of the parasite through and along the inside of the spicules can be seen." These tubes are said to be crammed with large spores, and both tubes and spores are carbonized. The parasite is further stated to "have grown at the expense of the organic matter of the spicules during the lifetime of the organism" (*i. e.* the sponge), and from the knowledge of the physiology of the *Achlya*-group it is not probable that they could penetrate and live in silica (*l. c.* p. 90). In the September number of the 'Annals' (seven years later) Prof. Duncan repeats his statements respecting this asserted parasite, and still maintains that it "grew and lived in the sponge as it did in the corals of the same age, and was not introduced after fossilization" (*l. c.* p. 228).

Considering now the character of this asserted parasite, *Palæachlya perforans*, Dunc., which forms such an important argument, in Prof. Duncan's estimation, for the original calcareous nature of the sponge *Hindia*, the first point I wish to notice is that, according to the author's own statement, it is not probable that it could penetrate and live in silica. In this case it is difficult to account for its presence in the long canals and the interspaces in the examples of *Hindia* from New Brunswick, in which Prof. Duncan noticed it, since these spaces *are* filled with silica in the form of chalcedony and quartz. This siliceous matrix is interpenetrated with the so-called *Palæachlya*, which Duncan asserts could not bore into such mineral structures. Respecting the nature of the mineral which fills up the canals and interspaces in the New Brunswick specimens, Prof. Duncan has stated †: "The fossils are infiltrated with clear transparent or rather dusky calcite, with very few cleavage-planes, and in some places giving indications, under polarized light, of a more or less acicular or fibrous structure, like aragonite. Rhombs of calcspar exist here and there; and the intensity of the colours elsewhere, under the crossed Nicols, varies much." Again, on p. 90: "It does not appear to me to be likely that these parasitical plants penetrated after the *calcareous* ‡ fossilization of the interstices was completed." The materials thus described with such minuteness of detail, as calcite and aragonite, are

* The name originally given by Prof. Duncan to the form here referred to is *Palæachlya perforans* (Quart. Journ. Geol. Soc. 1876, vol. xxxii. p. 210), and it is evident that he has here mistakenly used the term "*penetrans*." I propose to revert to the original name.

† 'Annals,' 1879, vol. iv. p. 86.

‡ The *italics* are my own.

in reality, as already mentioned, chalcedony and quartz. This I have proved by testing with acid and by polarized light some of the same specimens from New Brunswick which Prof. Duncan examined, and he has therefore palpably made a very serious error of observation, owing to which his important argument for the original calcareous nature of *Hindia* at once collapses; for as he states* that the *Palæachlya perforans* only inhabits calcareous structures, then the tubes or threads in this siliceous material cannot be due to this organism.

But Prof. Duncan further states that the *Palæachlya* has perforated the calcareous spicules of *Hindia* as well as bored through the infilling matrix, which, as we have just shown, is siliceous. If this were the case it would indicate a marvellous capacity of penetration in this lowly organism, to be able to make its way directly through both calcite and silica indiscriminately. But in this matter also there seems to be another error of observation on Prof. Duncan's part, to which Dr. Rauff first called my attention. After careful examination of the so-called tubes or borings of *Palæachlya* in New Brunswick specimens, Dr. Rauff failed to find a single instance in which they passed through the spicules of the sponge. They can be seen in microscopic sections to pass over and under them in close proximity, but not through them. My own observations confirm those of Dr. Rauff. It would thus appear that the action of the supposed *Palæachlya perforans* in the New Brunswick specimens of *Hindia* has been the reverse of what, according to Prof. Duncan, it should have been; for instead of penetrating calcareous structures exclusively, and eschewing the siliceous, it has left the calcareous spicules of the sponge intact, and bored only into the siliceous matrix!

There is, however, yet another point respecting this *Palæachlya perforans* which requires explanation. Prof. Duncan asserts that it carried on its borings "during the lifetime of the organism," *i. e.* the sponge; but in this case the canals during the lifetime of the sponge were mere open tubes, and

* Though Prof. Duncan reasserts in September 1886 what he stated in 1879, that no long tubular vegetable structures with organs of reproduction (i. e. *Palæachlya perforans*) have ever been found ramifying in *siliceous* skeletons, yet in 1881, in a paper "On some remarkable Enlargements of the Axial Canals of Sponge-spicules and their Causes," published in the Journ. Microsc. Soc., he writes that he agrees with Mr. Carter that the perforations in the *siliceous* spicules of recent sponges are produced by somewhat similar organisms to *Palæachlya perforans* (p. 568), and he also finds zoospores in these perforated siliceous spicules singularly resembling those of *Achlya perforans*.

the interspaces between the spicular meshwork would have been occupied by the soft living structures of the sponge. How could the borings therefore have been preserved if they were made in the fleshy portion of the sponge, or in the canals, when there are no traces of the soft structures themselves now remaining, and both the spaces formerly occupied by these structures and the canals have since been infilled with solid silica? Only on the supposition that the *Palæachlya* formed its own tubes of sufficiently hard materials to resist all the subsequent changes of fossilization can these dark threads in the siliceous matrix of *Hindia* be ascribed to this unicellular vegetable parasite, and Prof. Duncan * does not attribute to it this capacity.

From the above considerations it seems to me evident that whatever may be the nature of these tubes and dark filaments in the siliceous matrix of the New Brunswick specimens of *Hindia*, they do not correspond to the characters of the boring parasite, *Palæachlya perforans*, Dunc., and therefore they have no bearing whatever on the question of the original mineral nature of the sponge. Some of these supposed borings appear to me to be in reality the infilled axial canals of siliceous acerate or acuate spicules, which have found their way into the canals of the sponge. The faint outlines of the walls of these spicules can in some cases be clearly distinguished; but whether they are proper to the sponge or have merely found their way into its canals from the exterior I am not prepared to determine. I have noticed similar spicules cemented to the outer surface of Tennessee examples of *Hindia*, and I have also obtained them isolated by placing specimens in acid. Spicules of this character not unfrequently in the course of fossilization get their axial canals infilled with dark solid materials, which remain as rods or threads even after the spicular walls have been dissolved; and I believe some of the structures in the matrix of *Hindia* are of this nature. The dark granules, which are either scattered in the matrix or variously grouped to form the rods or threads, are regarded by Prof. Duncan as the carbonized oospores of the *Palæachlya*; but by employing high powers many of these granules can be seen to possess angular faces, and it has been suggested to me by Dr. Rauff that they are in reality small crystals of iron pyrites.

* Prof. Duncan has stated, however, in Quart. Journ. Geol. Soc. 1876, vol. xxxii. p. 206, that he has observed the *fossilized cellulose* wall of this very species of *Palæachlya* in the hard parts of a fossil *Thamnastræa*; but it would be far more wonderful to find its tubes and their contents preserved after they had penetrated the *soft* parts and the *empty canals* of this Silurian sponge.

The other reason alleged by Prof. Duncan for his belief in the original calcareous nature of *Hindia* is that the calcite of which the spicular structure of the New Brunswick examples at present consists is not in distinct crystals, and cleavage-planes are rare, and the mineralization resembles that of fossils which were originally of carbonate of lime. But though this calcite is not in crystals, a very slight amount of observation will show that it cannot be regarded as the original mineral of the sponge-skeleton, since it is filled with foreign dark grains and other particles of a similar nature to those present in the matrix of the rock in which the sponge has been imbedded. Its character shows that it has been derived from the finer sediments of the surrounding rock, which have found their way into the empty moulds left by the dissolution and removal of the original siliceous spicules. In fact, if we suppose the minute cavities in the silicified Tennessee examples to be filled with fine calcareous sediment, we should have structures produced like those of the New Brunswick specimens. Under some conditions, instead of this dusky non-crystalline material a true crystalline calcite has filled up the cavities, as in the case of specimens from Schoharie.

The various mineral conditions under which *Hindia* occurs are only such as may be found in fossil sponges which even Prof. Duncan would not hesitate to accept as of siliceous origin, such as, for example, the contemporary genera *Astylospongia* and *Aulocopium*. In these sponges, as well as in *Hindia*, the original spicular structure may be either as empty casts in a siliceous or calcareous matrix, or the casts may be infilled either with granular sedimentary calcite or with crystalline calcite, or with iron pyrites and peroxide of iron.

But I have lately succeeded in obtaining further evidence of the originally siliceous nature of *Hindia* by the discovery of a portion of a specimen in which the spicules are actually siliceous, and by the action of acid they can be isolated from the matrix and obtained separately. In this condition their surfaces are pitted and the expanded ends of the rays eroded in precisely the same manner as the siliceous spicules of many Cretaceous sponges.

Possibly it may be urged that these siliceous spicules are merely replacements of calcite by silica; but, on the other hand, in their form and character, and in their mode of union with each other to form the skeleton, they so distinctly resemble the siliceous spicules of both recent and fossil lithistid sponges, that the conclusion is inevitable that they must belong to the same group.

This resemblance is so palpable that even Prof. Duncan originally described *Hindia* as a lithistid sponge. But as the name lithistid was applied by Oscar Schmidt only to sponges with siliceous skeletons, it is therefore a decided misnomer thus to term *Hindia*, when it is regarded by Duncan as a calcareous sponge. If it is really a calcisponge it should stand alone as the only extinct representative of a distinct order in that group, since there is no other known calcisponge with spicules or a spicular structure at all resembling those of *Hindia*.

Prof. Duncan finally pleads, in the September number, that the former existence of a mimetic series of calcareous sponges is within reasonable distance of the truth, for who amongst us is to limit Nature as regards possibilities? (p. 228). But in determining the character of this fossil sponge, regard should first be taken for the *facts* of Nature, and if, according to all analogies, these point to the siliceous origin of *Hindia*, it is altogether beside the point to suggest the *possibilities* of Nature to produce a mimetic series of calcareous sponges, or to surmise that the group may have become extinct or merged into a higher form, as the parent of *Zoantharia perforata*. When such rash speculations depend mainly on the supposed fossilized filaments of an alga *, it is not surprising if they prove to be far from within reasonable distance of the truth.

I am able to confirm the careful descriptions of *Hindia* given in Dr. Rauff's paper in nearly every respect. The microscopic sections studied by this author showed more clearly the junction of the spicules than those at my disposal, and he has established the observation of Duncan that there are not more than four rays in the elementary spicule, whereas I thought it probable that the number might have varied from four to six †. He has also shown that the union of the spicules does not take place by the junction of the frilled ends of their rays with each other, as stated by Duncan and accepted by myself, and he explains Duncan's figures ('Annals,' 1879, vol. iv. pl. ix. figs. 1 *a*, 2, 2) by supposing that they have been drawn from a transverse section of the

* Prof. Duncan's statements respecting this fossil alga, *Palæachlya perforans*, require for their acceptance an unlimited faith in the possibilities of Nature. Not only does it exist in these Silurian sponges, but it has bored cavities in the scales of Cretaceous fishes, in the hard parts of both fossil and recent corals and shells, and, *mirabile dictu*, the same species still exists, and works its ravages on the bodies of our common house-flies—this is the aerial form of the *Achlya*! Who would have imagined a direct genetic connexion between the parasite of a Silurian marine sponge and that of a house-fly, dead on the wall?

† Cat. Foss. Sponges Brit. Mus. p. 57.

sponge, in which the real union of the spicules cannot be distinguished.

Having obtained some of the spicules of *Hindia* in a silicified condition and isolated from each other and from the

Fig. 1.

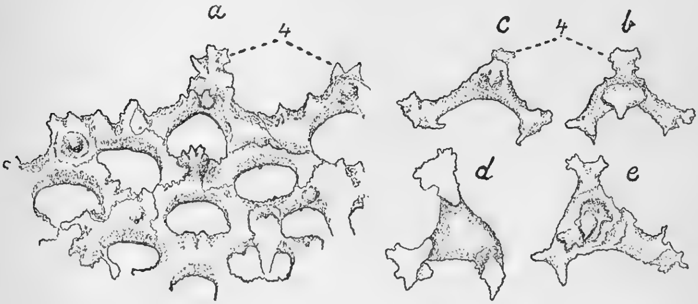


Fig. 2.

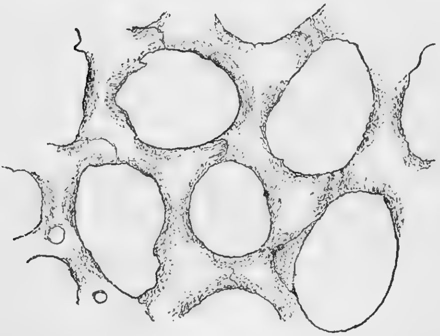


Fig. 1.—*a*, a fragment of the skeleton of *Hindia fibrosa*, Rœm., sp., showing in places the junction of the spicular rays; drawn from a longitudinal section of a specimen from New Brunswick. 4, the fourth or truncated ray of the spicules. *b, c*, two isolated siliceous spicules, viewed laterally. *d*, another spicule seen from below, showing the central node and the expanded ends of the rays. *e*, another spicule seen from above, showing the end of the fourth ray. Drawn under the camera lucida to the scale of 70 diameters.

Fig. 2.—Portion of a tangential section of *Hindia fibrosa*, showing the apertures of the radial canals. The individual spicules cannot be distinguished. Drawn to the same scale as fig. 1.

matrix, I am enabled to give further particulars respecting their form than could be obtained from studying them in the microscopic sections. In all the detached examples, which might be deemed complete, four arms or rays are present,

extending from a common inflated centre. Three of the rays are either straight or slightly curved, subequal, cylindrical in section and with expanded extremities; they form by their union, as Duncan has already stated, a tripod-shaped body from the upper surface of which the fourth ray projects. This fourth ray is always considerably shorter than the others, and in most cases is merely a short stumpy process, terminating in from two to four small, conical, slightly divergent spurs. In the silicified specimens (fig. 1, *b–e*) the frilled convex borders and extremities of the tripodal rays are considerably eroded, and the spurs of the fourth ray are only faintly indicated (*b*, 4); but they can be distinguished in the connected meshwork slightly projecting into the interspaces, even when the ray itself is concealed (fig. 1, *a*). The inflated nodes or centres of the spicules cannot be made out in a longitudinal section of the sponge (fig. 1, *a*), and even in a tangential section, owing to the manner in which the rays overlap each other, this character is masked (fig. 2); but in the detached spicules the centres are clearly shown (fig. 1, *d*, *e*).

The connected structure of the skeleton can be readily understood when once the true form of the individual spicules has been ascertained. In all cases the fourth or truncated ray points to the exterior of the sponge. The three diverging tripodal rays of each spicule extend towards the central nodes of three different proximate spicules next below, and their expanded terminations are intimately apposed to the centres and convex borders of the rays of these spicules. But as each spicule is connected by three rays with three different spicules of the proximate series below, so also does each support, on the upper portion of its node, three rays of different spicules which converge to it from the series above. The ends of these three converging rays are thus grouped round the truncated fourth ray of the spicule in such a manner that, when viewed in a longitudinal section, it is almost entirely hidden by them, and only its summit-spurs can be seen (fig. 1, *a*). The fourth ray thus serves as a centre and support for the rays converging to the spicule from above, and thus materially contributes to the firmness and strength of the skeleton.

Owing to the inflation of the central nodes of the spicules, the canals radiating from the central space to the surface of the sponge are subcircular or subelliptical in transverse section (fig. 2), the spicular nodes occupying the position of the angles shown in Dr. Rauff's diagrammatical figure *. The individual spicules and their union can hardly be distinguished in the tangential section (fig. 2), although drawn on the same

* 'Annals,' Sept. no., fig. 2, p. 174.

scale as the longitudinal section. In the silicified examples from Tennessee the casts of the spicules on the outer surface of the sponge are shown as Δ-shaped depressions, with minute circular holes at each of the angles, indicating the centres and rays respectively.

Considerable differences of opinion have been expressed as to the systematic position of *Hindia*. Dr. Rauff regards it as belonging to the Tetracladine family of lithistids; Zittel places it with the Megamorina; whilst I have ranged it under the Anomocladina. Dr. Rauff maintains that the number of the rays (when four are developed) and the angles at which they are given off from the centres correspond with those of Tetracladine spicules. On the other hand, the general characters of the elementary spicules and their mode of union with each other appear to me to indicate a closer relationship to typical Anomocladine sponges. The spicule fundamentally consists of a central node giving off simple rays with expanded terminations, which clasp the centres and convex surfaces of other spicules. In these features *Hindia* resembles such recognized Anomocladine genera as the Silurian *Astylospongia*, F. Rœmer, the Jurassic *Cylindrophyma*, Zitt., and the recent *Vetulina*, O. Sdt. In typical Tetracladine sponges, on the other hand, the four rays of the spicules radiate from a non-inflated centre; they usually branch near their extremities, and they join together by the interlocking of the branched ends with each other, thus materially differing from *Hindia*. It is true that the number of the rays is the same in *Hindia* as in Tetracladine sponges; but then one ray is only incipiently developed, and the resemblance in this respect appears to me to be more than counterbalanced by the material differences in others.

In the general regular construction of its skeleton, *Hindia* finds a close parallel in *Astylospongia* and *Cylindrophyma*; and in the particular feature of the disposition of the spicules, so that they form a series of arches, with the convexity towards the exterior, and the nodal summit of each arch supporting the bases of the arches next above, there is a close resemblance to the existing genus *Vetulina*, in which Sollas * has described a precisely similar arrangement. In no other family of lithistids is there, to my knowledge, the same regular construction of the skeleton as in *Hindia* and the other Anomocladine genera above mentioned, and I think therefore its true position is in this family in near proximity to the contemporary genus *Astylospongia*.

Some recent discoveries show that *Hindia* had a very wide

* "On *Vetulina stalactites*, O. Sdt., and the Skeleton of the Anomocladina," Proc. Roy. Irish Acad. 2nd ser. vol. iv. no. 4, p. 491.

distribution in Palæozoic strata. Prof. H. Alleyne Nicholson has sent me an imperfect calcified specimen from rocks of Ordovician age at Craighead, Girvan, Ayrshire; and from the Silurian at Wänge, Isle of Gotland, Prof. G. Lindström has forwarded me silicified casts. It also occurs in fragments of limestone of Trenton age (Ordovician) in Northern Illinois, which have been sent to me by Dr. W. R. Head, of Chicago. Some detached tripodal spicules discovered by Mr. J. Wright, F.G.S., of Belfast, in Carboniferous limestones at Sligo, and described and figured by Mr. H. J. Carter *, also appear to me to belong to a sponge of this genus. Its occurrence in Tennessee, New Brunswick, New York, St. Petersburg, and in the Drift of Northern Germany has already been recorded.

MISCELLANEOUS.

Description of a new Genus of Gymnosomatous Pteropoda. By M. Paul Pelseneer.

The author discusses the described genera of Gymnosomatous Pteropoda, of which he rejects *Ægle*, Oken, and *Cirrifer*, Pfeffer, as synonymous with *Pneumoderma*, Cuv.; while *Cliodita*, Q. & G. = *Clione*, Pall., *Eurybia*, Rang = *Halopsyche*, Bronn, *Pneumodermopsis*, Bronn = *Dexiobranchæa*, Boas, and *Trichocyclus*, Eschsch., and *Trigonius*, Busch, are founded upon larval forms. *Pelagia*, Q. & G., and *Cymodocea*, d'Orb., are provisionally rejected as insufficiently characterized. Six genera are accepted by the author, as tabulated below :—

1. Visceral envelope presenting a specialized branchial apparatus	2.	
Visceral envelope presenting no special branchial apparatus	5.	
2. Acetabuliferous buccal appendages	3.	
No acetabuliferous buccal appendages	4.	*Clionopsis*, Trosch.
3. No posterior branchia	1.	*Dexiobranchæa*, Boas.
A posterior branchia	4.	
4. Posterior branchia presenting four symmetrical rays	2.	*Pneumoderma* †, Cuv.
Posterior branchia consisting of a membranous ring	3.	*Spongiobranchæa*, d'Orb.
5. Body elongated, pointed behind	5.	*Clione*, Pall.
Body ovoid, rounded behind	6.	*Halopsyche*, Bronn.

These genera are ranged under four families, namely :—1. Pneumodermatidæ (genera 1–3); 2. Clionidæ (genus *Clione*); 3. Halopsychidæ (genus *Halopsyche*); and 4. Clionopsidæ (for *Clionopsis*).

* 'Annals,' ser. 5, vol. vi. p. 212, pl. xiv. figs. 10, 11.

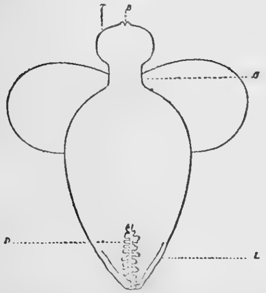
† Throughout his paper the author has altered Cuvier's name to *Pneumonoderma*, a change which is manifestly incorrect. Cuvier's name conveys the idea that the animal breathes by its skin; the alteration would give it "skin-lungs" or a "lung-skin"!

The new genus described by the author, which is founded upon a specimen in the National Museum at Washington, enters into none of these families. He names it

NOTOBRANCHÆA.

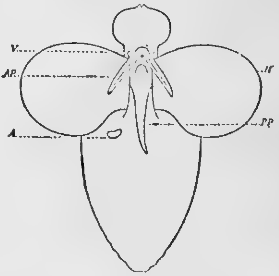
Char. Body contracted behind, presenting only a posterior branchia, formed by three crests (one dorsal and two lateral), of which the dorsal one alone is fringed. Anterior and posterior lobes

Fig. 1.—Dorsal view, ×4½.



B, mouth; C, neck; D, dorsal branchial crest; L, lateral branchial crest; T, head.

Fig. 2.—Ventral view, ×4½.



A, anus; N, fin; AP, anterior, PP, posterior lobes of the foot; V, orifice of the penis.

of the foot long and narrow, the former free in their posterior two thirds. These are also the characters of the family Notobranchæidæ.

The only species known to the author, which is represented by a single specimen in the United States National Museum at Washington, is named by him *Notobranchæa MacDonaldii*, in honour of Dr. MacDonald, who has recorded a similar arrangement of the branchia in a small Gymnosome collected by him off Sydney. The described specimen was obtained off Carolina in N. lat. 38° 10′, and W. long. 74° 15′, by the steamer 'Albatross.' It measures 8 millim. in length.

In conclusion the author discusses the phylogenetic relations of the Gymnosomata, which he regards as having originated from the Aplysians, to which *Dexiobranchæa* (= *Pneumodermopsis*, Bronn *) comes nearest, being less specialized and possessing only the lateral branchia. *Spongiobranchæa* possesses a very simple posterior branchia, a specialization of the posterior ciliated ring which persists so long in *Dexiobranchæa*; while *Pneumoderma* shows a great complication of this posterior branchia by the presence of four crests radiating from the original ring. *Clionopsis* shows retrogression, the lateral branchia having quite disappeared and the posterior one become much simplified; and in *Clione* and *Halopsyche* there are no traces of a special branchial apparatus. *Notobranchæa* seems to represent the forms from which *Clione* originated.—*Bull. Sci. Dép. du Nord*, sér. 2, ann. ix. no. 6.

* It is not very clear why this generic name is abolished in favour of *Dexiobranchæa*.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 110. FEBRUARY 1887.

X.—*The Generic Position of* Solanocrinus. By P. Herbert Carpenter, D.Sc., F.R.S., F.L.S., Assistant Master at Eton College.

Some very valuable observations upon the structure of the Upper Jurassic Crinoids have been recently published in the 'Palæontographica' by Dr. J. Walther *, of Jena. He has worked with great care and patience at a number of different species, and has been able to expose several portions of their organization which have been hitherto concealed by matrix. To me personally his observations have a very special interest, for in more than one case they throw light upon questions which have been before my mind for some time past. These will be fully discussed in the Report upon the 'Challenger' Comatulæ, which is now passing through the press. But I propose here to say a few words about another question which Walther has reopened after it had been thought to be finally settled, viz. whether *Solanocrinus* can be retained as a Comatulid genus distinct from *Antedon*. The history of these generic names, the first of which originated with Goldfuss †,

* "Untersuchungen über den Bau der Crinoiden, mit besonderer Berücksichtigung der Formen aus dem Solenhofener Schiefer und dem Kelheimer Diceraskalk," Palæontographica, 1886, Bd. xxxii. pp. 155–200, Taf. xxiii.–xxvi.

† 'Petrefacta Germaniæ,' Theil i. p. 166.

has been fully explained by Schlüter and myself, and there is therefore no need to go into it again, except as regards one point.

The genus *Antedon* was established by De Fréminville in a "Mémoire sur un nouveau genre de Zoophites de l'Ordre des Radiaires" (Bull. Soc. Philom. Paris, 1811, tom. xi. p. 349). In this notice De Fréminville described a new species, *Antedon gorgonia*, and referred for illustration to figure 6 on pl. cxxiv. of the 'Encyclopédie Méthodique,' which was then in course of publication; and this fact has led Perrier * to say, on p. 79 of his elaborate monograph on the structure and development of *Antedon rosacea*, that the name *Antedon* was "donné en 1811 par Fréminville dans l'*Encyclopédie Méthodique* à l'Astérie rosace de Linck." This statement is entirely incorrect, for De Fréminville never wrote in the 'Encyclopédie' at all.

Schlüter †, while regarding *Solanocrinus* as a synonym of *Antedon*, suggested at the same time the possibility of limiting the name to those fossil Comatulæ which have a round axial opening on the upper surface of the centro-dorsal and no radial pits on its lip. Zittel ‡ took this course in his Palæontology, where he described *Solanocrinus* as a subgenus of *Antedon*; and his pupil, Dr. Walther, has gone yet further. He defines *Solanocrinus* as follows § :—"Ungestielte Crinoiden von sehr variirender Form, Centrodorsale mit rundem Nahrungscanal ohne Radialgruben, mit schmalen lanzettförmigen Basalia, mit 2 oder 3 Radialia, 10 oder 20 Armen, ohne Syzygialnähte."

Only two of the characters mentioned in the preceding definition could possibly be of any value in the separation of *Solanocrinus* from *Antedon*, viz. the nature of the centro-dorsal and the absence of syzygies in the arms. It seems to have escaped Dr. Walther's notice that I discussed Schlüter's proposition seven years ago ||, and showed how utterly impossible it is to make the presence or absence of radial pits on the centro-dorsal a character of generic value. Schlüter himself admits that these pits are not always present in

* "Mémoire sur l'Organisation et le Développement de la Comatule de la Méditerranée (*Antedon rosacea*, Linck)," Nouv. Arch. du Mus. d'Hist. Nat. Paris, 1886, t. ix. fasc. 1, pp. 53–176, pls. i.–x.

† "Ueber einige astylide Crinoiden," Zeitschr. d. deutsch. geol. Gesellsch. Jahrg. 1878, p. 36.

‡ 'Handbuch der Palæontologie,' Bd. i. p. 396.

§ *Op. cit.* p. 175.

|| "On some undescribed Comatulæ from the British Secondary Rocks," Quart. Journ. Geol. Soc. 1880, vol. xxxvi. pp. 36–40.

Solanocrinus scrobiculatus *, and I pointed out that it recent Comatulæ be divided into two groups, according as they have (*a*) radial pits and a five-lobed axial opening, or (*b*) no radial pits and an undivided opening, *Antedon rosacea* and *A. celtica* "would appear in both groups, while some individuals with lobate or decagonal openings, but no pits, would find a place in neither."

The latter condition is an extremely common one; but radial pits are decidedly rare in recent Comatulæ, quite a number of which have a round axial opening on the centro-dorsal without any pits on its margin, just as in *Solanocrinus* as defined by Walther.

The only character, then, on which Walther can rely for his revival of *Solanocrinus* as a genus distinct from *Antedon* is the supposed absence of any syzygies in its rays and arms; and he says of every one of his specimens that "Syzygialnähte fehlen." His own descriptions and figures appear to me to show, however, that quite the reverse is the case, and that in the three species which he refers to *Solanocrinus* we have the predecessors of a very small group of recent forms of *Antedon* in which the second and third radials are united by syzygy.

Let us consider first the type species, *Solanocrinus costatus*, three examples of which are described and figured by Walther. On Taf. xxv. fig. 1 he represents a portion of a ray which consists of the two outer radials with the bases of the two arms that are borne on the axillary. His own description† of it commences as follows:—"Das Stück beginnt mit dem aus Radiale II. und Radiale III. verschmolzenen Axillare, welches eine Verwachsungsnath wohl erkennen lässt." But if this "Verwachsungsnath" is not a syzygy, what is it? It is well shown in Walther's figure on the ventral side of the compound axillary; and a comparison of this figure with the corresponding parts of the recent *Actinometra paucicirra* (fig. 1, B, p. 84) leaves little doubt in my mind that in the fossil, as in the recent type, there is a syzygial union between the two outer radials. In like manner Walther says of another example (of *S. costatus*) that the second radials "mit dem Radiale III. verschmolzen, aber durch eine Rinne davon abgegrenzt sind." Here again we seem to have distinct evidence that the two outer radials are united by syzygy, just as in many recent Comatulæ (fig. 1, A). Walther says in his specific diagnosis of this type:—"Radiale II. mit Radiale III. verschmolzen, doch durch eine Nahtlinie getrennt." His non-recognition of this as a syzygial union is the more

* *Loc. cit.* p. 34.

† *Op. cit.* p. 171.

remarkable since, on p. 172 of the 'Encriniden,' a work which Walther quotes freely, Quenstedt says that the second radial of *Solanocrinus* "stets mit dem dritten Radial, einen Doppel-

Fig. 1.

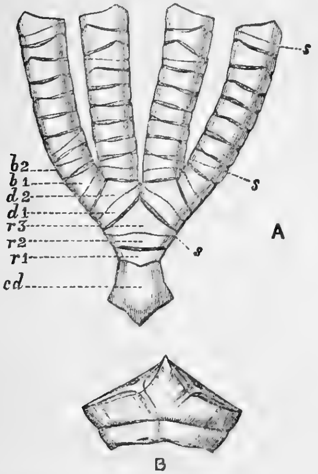


Fig. 2.

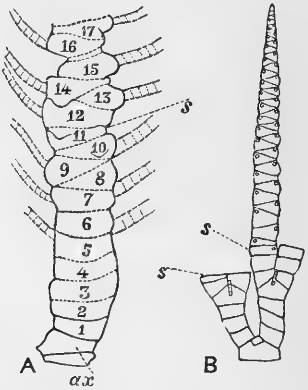


Fig. 1.—*Actinometra paucicirra.* A. Dorsal view of the lower part of a ray, showing the syzygies (*s*) in the radials, distichals, and brachials, × 2: *cd*, centro-dorsal; r^1, first radial; r^2, r^3, second and third radials united by syzygy; d^1, d^2, first and second distichals united by syzygy; $b,^1$ b^2, first and second brachials united by syzygy. B. Ventral aspect of the united second and third radials, × 4.

Fig. 2.—A. Copy of a portion of Walther's diagram of the arm-structure in *Solanocrinus costatus*: *ax*, third or axillary radial; *s*, syzygy. B. Copy of Walther's diagram of the arm-structure in *S. gracilis*, var.: *s*, an apparent line of syzygy.

gelenk (axillare) innig verwachsen blieb, ähnlich den Syzygien der Armglieder." These syzygies of *Antedon Eschrichti* are represented on fig. 16 of the same plate (Tab. 96) as the figures of *Solanocrinus costatus*.

I have Quenstedt's authority therefore for saying that there is a syzygy between the two outer radials of *Solanocrinus costatus* *, and I strongly suspect from the appearance of his fig. 26 *a* on Tab. 96 that the apparently simple first brachial is also a syzygial joint, just as in those recent ten-armed Comatulæ which have the two outer radials united by syzygy (*Actinometra solaris*, &c.).

But whether this be the case or not, the condition of one of Walther's own specimens, as interpreted by himself, seems

* Compare his Tab. 96. figs. 26, 28, 48.

to me to prove most conclusively that the arms of *Solanocrinus costatus* are not so entirely devoid of syzygies as he asserts. On Taf. xxvi. fig. 11, he gives a "Schema des Armbaues von *S. costatus*, mit ergänzten Pinnulis," a part of which I have copied in fig. 2, A. The first pinnule is represented on the left side of the fifth brachial, and five others follow in succession, alternating on opposite sides of the arm till the tenth joint. But there is no pinnule at all upon the broad side of the eleventh joint, which is continuous with that of the twelfth, and this bears a pinnule which is on the opposite side of the arm to that on the tenth joint. If this arrangement be not due to a malformation, which I see no reason to believe, it has only one possible explanation. The eleventh and twelfth joints are united by syzygy, and the eleventh, as is invariably the case with the hypozygal, bears no pinnule. So far as my experience goes, there is no other possible way of accounting for the absence of a pinnule on this joint; and, if Walther's restoration of the arm is justified by the condition of the specimen, I have no hesitation whatever in saying that there must be a syzygial union between this pinnule-less joint and its successor. I think that this will be evident to any one who will compare the copy of Walther's figure (fig. 2, A) with that showing the syzygies in the arm of *Antedon rosacea* (fig. 3, C).

Fig. 3.

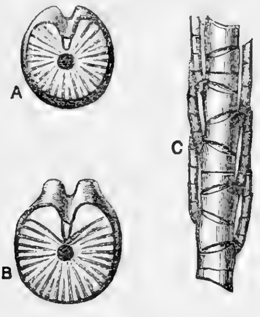


Fig. 3.—Syzygies in the arm of *Antedon rosacea.* A, epizygal; B, hypozygal; C, dorsal aspect of an arm-fragment, showing the syzygial unions and the alternation of the long sides of the arm-joints: $\times 4$.

Let us now turn to his description of the type form of *Solanocrinus gracilis*. I have little doubt, for reasons which I shall presently explain, that the pentagonal and relatively long axillaries of this individual, both radial and distichal,

are really compound joints, consisting respectively of the original second and third radials or first and second distichals, united by syzygy. So far as the radials are concerned, Walther himself suggests as a possibility * that the axillary should be regarded as "verschmolzenes Radiale II. + Radiale III." Quenstedt's observations on the axillaries of *S. costatus* show that the line of syzygy, which is so plain in some specimens, may disappear altogether in others †; and it is therefore quite possible that it may have disappeared in Walther's *S. gracilis.* I should not like to speak with certainty as to the presence of syzygies in the arms of this specimen, but there are certain indications in both the figures which Walther gives of it which lead me to think that syzygies are not so entirely absent as he asserts; while his "Schema des Armbaues" of a varietal specimen ‡, which I have copied (fig. 2, B) shows, in what seems to me the clearest possible manner, that the third brachial is a syzygial joint in one arm, and that another has been broken at a syzygy in the second brachial, so that the hypozygal only remains.

We now come to *Solanocrinus imperialis.* According to Walther's figures and description of this unique specimen §, the second radials are the axillaries. Now it is a very general rule among those Neocrinoids in which the rays divide that there are three radials in the calyx. This holds good in the Encrinidæ, Apiocrinidæ, *Pentacrinus*, *Bathycrinus*, and for all the recent Comatulæ, though there are a very few fossil species of *Antedon* in which the second radial is undoubtedly axillary, a fact for the knowledge of which I am indebted to the kindness of M. de Loriol.

The possibility of the large radial axillaries of *Solanocrinus imperialis* being compound joints does not seem to have occurred to Walther, as it did in the case of *S. gracilis.* To my mind, however, this is by no means an improbable supposition, for the characters of the axillaries are such as I have never met with in recent Comatulæ unless they are syzygial joints. They are very suggestive of the compound axillaries in the group of species represented by *Actinometra solaris* and its allies, and also closely resemble those of *Actinometra paucicirra*, which are shown in fig. 1, A. In this latter type the distichal series consists of two joints united by syzygy, and there is a similar union between the first two brachials. I cannot avoid the suspicion that this is likewise

* *Op. cit.* p. 174.
† Encriniden, Tab. 96. fig. 43, p. 175.
‡ *Op. cit.* Taf. xxvi. fig. 4.
§ *Op. cit.* pp. 168–171, Taf. xxv. fig. 3, Taf. xxvi. fig. 6.

the case in Walther's *Solanocrinus imperialis* and also in *S. gracilis.* The five single axillaries in the former type, which he describes, may really be double or syzygial joints; while the two elements of the syzygy are more distinctly separated in the other five primary arms. Without seeing the specimen, however, I should not like to speak positively upon this point, though my experience with several recent Comatulæ leads me to think it by no means an improbable supposition.

But whether *Solanocrinus imperialis* have two radials only, as described by Walther, or three with the two outer ones united by syzygy, as seems to me not unlikely, I am pretty sure that the arms were not so entirely devoid of syzygies as they are said to be by Walther. Thus, for example, in Zittel's figure of the specimen * there is an unmistakable syzygy represented in the third arm from the bottom on the right side. The first thirteen brachials above the distichal axillary are very regular, and, the lowest ones excepted, they show a distinct alternation of long and short sides; but the thirteenth joint is followed by two others (fourteenth and fifteenth), *both* of which are longest on the opposite side of the arm to its own longer side, and the long side of the joint which succeeds them (sixteenth) is on the same side of the arm as this is. To my mind this proves clearly that the fourteenth and fifteenth brachials are united by syzygy, exactly as in the arm of *S. costatus*, which I have already discussed. It is singular, however, that there is no trace of this arrangement in the corresponding arm in either of Walther's figures of this unique speicmen. It is No. 13 of his nomenclature; but the condition of arm No. 2, as shown in both his figures, seems to me to point unmistakably to the presence of a syzygy. The twenty-first joint, which is at the widest part of the arm, is unusually short, its distal edge being transverse, and not oblique to the axis of the arm, as those of the joints immediately preceding are. In fact, the normal arm ends here, and a small curved stump projects from the middle of the distal face of the short twenty-first joint; but its diameter is very much less than that of the normal arm. This sudden constriction of the diameter of the arm appears to me to be due to the fact that it had been regenerated, and that the unusually short twenty-first joint is the hypozygal of the syzygy at which the distal part of the arm broke off. Walther's own experiments at Naples showed him that regeneration takes place twice as frequently from a syzygy as from an articulation; and the fact that the plane of regeneration is in this case transverse, and not oblique to the axis of the arm,

* Palæontologie, p. 396.

shows that it must have taken place at a syzygy; while the unusual shortness of the preceding joint points to the same conclusion.

I have gone into this question more fully than would have been desirable in the Report on the 'Challenger' Comatulæ, because I wished to explain in detail my reasons for still regarding *Solanocrinus* as a synonym of *Antedon*, and not as an independent genus. There are many recent Comatulæ in which syzygies are comparatively rare upon the arms, only occurring at intervals of twenty joints or so; and I cannot but think that Walther has been a little premature in attempting to revive Goldfuss's genus. The progress of research may ultimately reveal other characters which will give *Solanocrinus* a definite generic position, but at present I cannot admit that it has any claim to be separated from *Antedon*.

There is much more in Walther's memoir which I should like to discuss at length. He calls the primary tentacles which are extended from the water-vascular ring of the Pentacrinoid larva "Embryonal-Pinnulæ;" and he further says that they have no great resemblance to the tentacles which ultimately appear in connexion with the radial water-vessels along the sides of the brachial ambulacra. This is a sufficiently remarkable statement, but it is altogether eclipsed by his assumption "dass die Embryonal-Pinnulæ den definitiven Pinnulis homolog sind." He further identifies these five primary tentacles of the young larva with the clavicular pieces * on the radial axillaries of the adult; and he copies my figure of the axillary of *Pentacrinus Wyville-Thomsoni* to show "dass die Gattung *Pentacrinus* die primäre mediane Pinnula in recht auffälliger Weise bis zum heutigen Tage erhalten hat" †. It passes my comprehension altogether how Walther can seriously believe that the delicate tubular appendages of the ambulacral ring in the early larva can be homologous with anti-ambulacral calcareous structures like the jointed pinnules at the side of the arms of the adult, or with the solid clavicular pieces which are parts of the radial axillaries. His theory recalls Hambach's notions about the supplemental pore-plates of *Pentremites* being the collapsed remnants of "soft and membranaceous" tentacles like those at the sides of the ambulacra in *Echinus*, and I cannot imagine that it will ever be accepted by morphologists; but Walther takes these and other scarcely less remarkable statements as the foundation of a long discussion respecting the phylogeny of the Crinoidea, about which I propose to offer some remarks on a future occasion.

* I believe this name to be due to Schultze ("Monographie der Echinodermen des Eifler Kalkes," p. 5 (117).

† *Op. cit.* p. 183.

XI.—*On a* Crangon, *some Schizopoda, and Cumacea new to or rare in the British Seas.* By the Rev. Canon A. M. Norman, M.A., D.C.L., F.L.S. *

The Scotch Fishery Board have sent me for examination some of the higher Crustacea which have been met with during the past year. Among them are many species of interest, and these are recorded in the following notes. With few exceptions the several forms are now first published as members of our Fauna, although some of them have been long known to myself. Mr. Brook and Mr. Scott must be congratulated on the success which has brought these species to light, and their discovery will, I trust, lead other naturalists to realize how much remains to be done among the great class of Crustacea in our seas, and that careful investigation will be amply rewarded even among the higher orders; but no real progress can be made with respect to the food of fishes until investigators are familiar with those smaller Crustacea which constitute so large a portion of that food. As an instance of this I may mention that Dr. Baird, many years ago, published an interesting paper on the food of the vendace. No author at that time was more competent to undertake the task, and one of the Entomostraca in the stomachs was new to science, *Bosmina coregoni*, and has not as yet been met with elsewhere in our islands than in Lochmaben. Yet when I repeated these investigations three years ago, I found that while the vendace fed on those species recorded by Dr. Baird, a large portion, perhaps in bulk the largest portion, of its food, was *Leptodora hyalina*, an Entomostracan unknown to Dr. Baird, and which, from its extraordinary tenuity, delicacy, and transparency, and its totally different form from that usual among Cladocera, was no doubt passed over by my old friend as something he could not make out, though it is much larger than the species he satisfactorily determined. A "more dainty dish to set before a" fish cannot well be imagined than *Leptodora hyalina*, an animal so transparent that, notwithstanding its size, it can scarcely be detected in a glass of water unless held up to the light.

* [It seems desirable that this paper should be printed in the 'Annals,' as 'The Fourth Annual Report of the Fishery Board of Scotland,' in which it has already been published, is hardly likely to have extensive circulation among carcinologists.—A. M. N.]

Order CARIDA.

Genus Crangon, Fabricius.

Crangon (*Cheraphilus*) *neglectus*, G. O. Sars.

Cheraphilus neglectus, G. O. Sars, "Oversigt af Norges Crustaceer" (Christ. Vidensk. Forhandl.), 1882, p. 45, pl. i. fig. 7.

Rostrum *well rounded at the extremity*. Carapace with a single central spine, and a *second small tubercle-like spine on the central line behind it*, without the lobe-like folds of *fasciatus*, and with the sulcus which in that species defines their lateral regions much less distinct and deep. Antennal scale not greatly widened at the base. Last joints of maxilliped not broadly flattened. Second peræopod longer, reaching one third the length of the hand of first pair; its chela very weak, the finger and thumb parallel and touching each other, and apparently altogether too feeble to be used for grasping. Body not speckled with brown. Carapace more or less suffused with rufous or chestnut colour; a band across the fourth segment of pleon, and a second across the telson and uropods of the same colour.

"Ad oras meridionales et occidentales Norwegiæ in prof. 2–6 orgyarum fundo arenoso" (*G. O. Sars*). Haakelsund, Kors Fiord, Norway, 3 fathoms (*A. M. N.*), Tarbert, Loch Fyne (*Scotch Fishery Laboratory*).

I took six specimens of this shrimp, male and female, in 1878, in 3 fathoms water, at Haakelsund, Kors Fiord, West Norway, but at the time, from its general resemblance to *C. fasciatus*, passed it over as that species, as no doubt Norwegian naturalists had also done. In 1882 it was described by Prof. G. O. Sars. Mr. Scott has now added it to the British fauna, having forwarded to me for examination two or three small specimens which were taken at Tarbert. No other British specimens of this species are in my own collection, but it is not improbable that some of the northern specimens which have been referred to *C. fasciatus* belong to this new form. The two species to the unaided eye resemble each other closely, and one is apt to be led astray by the circumstance that, like *C. fasciatus*, *C. neglectus* commonly has the carapace dark-coloured, and a band of colour across the third segment of the pleon, and another across the telson and uropods; but the colour of these bands is chestnut ("badia," Sars) in *neglectus*, but deep umber-brown in *fasciatus*.

Crangon fasciatus, Risso.

Crangon fasciatus, Risso, Crust. de Nice, p. 82, pl. iii. fig. 5, and Hist. Nat. de l'Eur. Mérid. v. p. 64; Milne-Edwards, Hist. des Crust. ii.

p. 342; Bell, Brit. Crust. p. 259; White, Pop. Hist. Brit. Crust. p. 107; Lucas, Hist. Nat. Anim. Artic. Alger. p. 38; Heller, Crust. des südlichen Europa, p. 228, pl. vii. fig. 10.

Ægeon fasciatus, Kinahan, Britannic Species of *Crangon* and *Galathea*, p. 76, and woodcut.

Rostrum *broadly and abruptly truncate at the extremity*, its sides bending upwards, so that it is deeply sulcate in the centre. Carapace bearing a single central spine, on either side of which and between it and the margin are three slight lobe-like folds. Between this portion of the carapace and its hinder margin is a deeply cut sulcus arching forwards at the sides. Antennal scale short and very broad, unusually expanded on the inner side at the base. Maxillipeds with the two terminal joints broad and flattened. Second peræopods very short, just reaching the base of the hand of the first pair, the chela well developed (for a *Crangon*). Animals more or less speckled with dark brown, the carapace sometimes being entirely suffused with that colour. The epimera of the second, third, and fourth segments of the pleon are generally marked with the same colour, and also two transverse bands, one on the fourth segment, the other across the telson and uropods.

Specimens of this species are in my collection from Jersey (*Sinel and Co.*), Guernsey and Falmouth (*A. M. N.*), Starcross, Devon (*Mr. C. Parker*), Weymouth (*Mr. P. H. Gosse*). I have also recorded it from Shetland, but cannot at this moment lay my hands on the specimens to re-examine them.

Other recorded localities are Salcombe Bay (*Mr. Alder*), Dublin and Belfast (*Dr. Kinahan*), Galway (*Dr. Melville*), Mediterranean (various authorities).

Order SCHIZOPODA.

Family **Euphausiidæ.**

Genus Boreophausia.

Boreophausia, G. O. Sars, Preliminary Notice on the Schizopoda of H.M.S. 'Challenger' expedition (Christ. Vidensk. Forhandl. 1883, no. 7), p. 12; Report 'Challenger' Schizopoda (vol. xiii.), 1885, p. 64.

Boreophausia Raschii (M. Sars).

Thysanopoda Raschii, M. Sars, "Om Slægten *Thysanopoda* og dens Norske Arter" (Christ. Vidensk. Forhandl. 1863), p. 14.

Euphausia Raschii, G. O. Sars, "Oversigt af Norges Crustaceer" (Christ. Vidensk. Forhandl. 1882, no. 18), p. 51.

First found by M. Sars in the Christiania Fiord, and subsequently by his son, Prof. G. O. Sars, on the west coast of Norway.

It has lately been added to the British fauna. Dr. Henderson has forwarded to me specimens for examination which were taken in the tow-net in the Firth of Forth by the Scottish Marine Station. I procured it in the same way in July last in Loch Fyne, when with Mr. J. Murray on board the 'Medusa,' the vessel of the Scottish Marine Station, and, subsequently to my leaving, it was again taken by the 'Medusa' between the islands of Bute and Cumbrae; and now (February 1886) Prof. Ewart has found specimens in the stomachs of herrings caught on the east coast, and examined by the Scotch Fishery Board.

Genus Nyctiphanes, M. Sars.

Nyctiphanes, G. O. Sars, Preliminary Notices Schizopoda, 'Challenger' (Christ. Vidensk. Forhandl. 1883), p. 23; Report 'Challenger' Schizopoda (vol. xiii. 1885), p. 114.

Nyctiphanes norvegica (M. Sars).

Thysanopoda norvegica, M. Sars, Forhandl. Scand. Naturf. i Christiania, 1856, p. 169; id. "Om Slægten *Thysanopoda*" (Christ. Vidensk. Forhandl. 1863), p. 2; G. O. Sars, "Oversigt af Norges Crustaceer" (Christ. Vidensk. Forhandl. 1882), p. 50; Norman, Last Report Dredging among the Shetland Isles (Brit. Assoc. Report, 1868), p. 265.

Thysanopoda nana, M. Sars, Om Slægten *Thysanopoda*, p. 15 (junior).

Nyctiphanes norvegica has been found throughout the entire length of the Norwegian coast from Christiania to Vadso (*G. O. Sars*); and I am indebted to Prof. G. O. Sars for Norwegian specimens.

It has been known to me as a member of the British fauna for twenty-five years, having been first found by myself at Shetland, and a few years afterwards sent to me about the same time by Mr. David Robertson from the Firth of Clyde, and by Mr. Thomas Edward from the Moray Firth.

The following are additional localities of specimens in my collection:—

1. Tow-net, Valentia Island, 1870. A. M. N.
2. Taken seven miles off the Berling Islands, coast of Portugal, by Mr. Davidson, July 22, 1870, when on board the 'Porcupine.'
3. 'Porcupine,' 1869; lat. 60° 34′ N., long. 4° 40′ W.
4. 'Triton,' August 1882, abundant in the Faroe Channel.
5. Eastport, N.E. America, from Prof. S. I. Smith.
6. Observed in 1880 by me when on board the French exploring-vessel 'Le Travailleur' in the Bay of Biscay.
7. During the summer of last year I procured it with the towing-net, when with Mr. Murray in the 'Medusa,' in Loch

Fyne. Subsequently other specimens were forwarded to me which had been taken in Loch Long (Clyde); these exceed in dimensions all others that I have seen, and measure 50 millim. long.

8. Lastly, Prof. Ewart has sent me specimens taken from the stomachs of herrings on the east coast of Scotland.

The species would thus seem to be universally distributed over the North Atlantic Ocean, though it was not met with by the 'Challenger' expedition.

Nyctiphanes may be at once known from the other genera of the Euphausiidæ by the presence of a scale-like process on the basal joint of the antennules, which is projected upwards, and would seem to form a sort of screen for the eyes.

Tribe MYSIDEA.

Genus ERYTHROPS, G. O. Sars.

Erythrops pygmæa, G. O. Sars.

Nematopus elegans, G. O. Sars, Beretning om en i Sommeren 1862 foretagen Zoologisk Reise i Christianias og Trondhjems Stifter, p. 42.

Nematopus pygmæa, G. O. Sars, Beretning om en i Sommeren 1865 foretagen Zoologisk Reise ved Kysterne af Christianias og Christiansands Stifter, p. 17.

Erythrops pygmæa, G. O. Sars, Monographi over de ved Norges Kyster forekommende Mysider, 1870, p. 33, pl. ii. figs. 20–28.

A very small species, about 6 millim. long, now added to the British fauna; the specimens procured by the Fishery Board Laboratory at Tarbert.

Genus MYSIDOPSIS, G. O. Sars.

Mysidopsis gibbosa, G. O. Sars.

Mysidopsis gibbosa, G. O. Sars, Beretning om en i Sommeren 1863 foretagen Zoologisk Reise, p. 28; Monographi over de ved Norges Kyster forekommende Mysider, 1872, p. 23, pl. viii. figs. 1–3.

A single specimen taken by myself at Valentia, Ireland, in 1870. Three females sent for examination by the Fishery Board Laboratory which were procured on a Zostera-bed at Tarbert, Loch Fyne, 1885. Now first recorded as British.

Mysidopsis angusta, G. O. Sars.

Mysidopsis angusta, G. O. Sars, Beretning om en i Sommeren 1863 foretagen Zoologisk Reise i Christiania Stift, 1864, p. 30; Monographi over Norges Mysider, 1872, p. 23, pl. viii. figs. 1–13.

A drawing of this species is before me, which was made

from a specimen sent for examination by Mr. T. Edward* from Banff in August 1863; a second British specimen has now (March 1886) been taken by the Fishery Board at Tarbert, Loch Fyne.

On the Norwegian coast it has been found in the Hardanger and Christiania Fiords and at Aalesund.

Mysidopsis angusta has a very narrow, lanceolate antennal scale, which is ciliated all round, and is about twice the length of the peduncle of the antennules. The telson is cleft at the apex, and the sides of the cleft are quite plain, that is, without any teeth or serration within the cleft, and by this character the species may be distinguished not only from the other species of *Mysidopsis*, but from all Mysidea which have as yet been described.

Genus Leptomysis, G. O. Sars.

Leptomysis lingvura, G. O. Sars.

Mysis lingvura, G. O. Sars, Beretning om en i Sommeren 1865 foretagen Zoologisk Reise, p. 21; Monographi over de ved Norges Kyster forekommende Mysider, 1879, p. 35, pl. xi.

Although not hitherto recorded as occurring in our seas, *Leptomysis lingvura* was found by me twenty-six years ago in great abundance at Howden, County Durham, and shortly afterwards at Seaham Harbour. It remained with a MS. name in my collection until it was described by Prof. G. O. Sars. In 1883 it was sent to me by Mr. C. Parker from Starcross, Devon, and last year one or two specimens were forwarded to me for determination from Tarbert, Loch Fyne, by the Scotch Fishery Board. It would thus seem that the species is widely distributed round our coast.

Genus Mysis, Latreille.

Mysis inermis, Rathke.

Mysis inermis, Rathke, Beyträge zur Fauna Norvegens, p. 20; Lilljeborg, Œfversigt af Vet. Akad. Handl. 1852, p. 3.
Mysis cornuta, Kröyer, Nat. Tidsskr. 3 R. B. I. p. 26, pl. i. fig. 3, *a–g*; Goës, Crust. Decap. Podoph. Marina Sveciæ, p. 14.
Mysis truncatula, G. O. Sars, Beretning om en i Sommeren 1863 foretagen Zoologisk Reise, p. 16 (monstrositas).
Mysis inermis, Norman, Last Report Dredging among the Shetland Isles (Rept. Brit. Assoc. 1868), p. 266; G. O. Sars, Monographi over ved Norges Kyster forekommende Mysider, 1879, p. 54, pl. xxvii.

Specimens of this species are in my collection from the

* This species is called, in a Catalogue of Crustacea at the end of Smiles's 'Life of a Scotch Naturalist,' "*Mysis mixta*." It is much to be regretted that that list should have been published without revision.

following habitats:—Baltic Sea (*Prof. Lovén*), Bergen, Norway (*Prof. Lilljeborg*). Kors Fiord, 1878, and Lervig, Hardanger Fiord, Norway, 1879; Shetland, 1867, in rock-pools; Guernsey, 1865; Oban, 1877; Cullercoats, Northumberland (*A. M. N.*). Tarbert, Loch Fyne, 1885 (*Scotch Fishery Laboratory*). It has been sent to me for examination from the Moray Firth by Mr. T. Edward.

Mysis arenosa, G. O. Sars.

Mysis arenosa, G. O. Sars, Nye Bidrag til kundskaben om Middelhavets Invertebratfauna, I. Middelhavets Mysider, 1876, p. 16, pls. v. & vi.

This small species, described from the Mediterranean, was added to the British fauna by Mr. C. Parker, who found specimens, in 1884, at Starcross, Devon, which he forwarded to me; and specimens have now been taken at Tarbert, Loch Fyne, by the Scotch Fishery Laboratory.

Mysis Lamornæ, Couch.

Mysis Lamornæ, R. Q. Couch, The Zoologist, 1856, p. 5286; Norman, Ann. & Mag. Nat. Hist. ser. 3, vol. vi. 1860, pl. viii. figs. 4–6; Goës, Crustacea Decapoda Podophthalmia Sveciæ, p. 15.

Mysis aurantia, G. O. Sars, Beretning om en i Sommeren 1863 foretagen Reise, p. 20.

Mysis Lamornæ, G. O. Sars, Monographi over de ved Norges Kyster forekommende Mysider, 1879, p. 65, pl. xxx.

This species is known to me from the following localities, whence specimens are in my collection:—Falmouth (*A. M. N.*), Banff (*Mr. T. Edward*), Seaham, County Durham (*Mr. G. Hodge*), Loch Goil (*Mr. D. Robertson*), Tarbert, Loch Fyne (*Scotch Fishery Laboratory*).

Genus Siriella, Dana.

(= *Cynthia*, Thompson.)

The more tangible generic characters are as follows:—Antennal scale subrhomboidal, the external margin naked until it terminates in a spine, whence it slopes to meet an inner margin, and is similarly setose; the scale has a small terminal joint, generally furnished with five setæ. Peræopods seven-jointed, the terminal joint or finger biarticulate and nail-formed, at the end of preceding joint a dense bunch of setæ, which are microscopically spined. Telson elongated, linguiform, entire at the apex, furnished with marginal and terminal spines, so arranged that smaller spines alternate with larger. Outer uropods two-jointed, first joint without setæ on external margin, but furnished with a series of spines, the three distal spines exceeding the others in size.

Pleopods of female as in *Mysis*; of male well developed, consisting of two multiarticulate swimming branches, with a curious two-lobed appendage attached to the base of the inner branch, one of these lobes being more or less spirally coiled.

Siriella Clausii, G. O. Sars.

Siriella Clausii, G. O. Sars, Middelhavets Mysider, 1876, p. 81, pls. xxix.–xxxi.

Rostrum acute, triangular, not reaching beyond middle of first joint of antennules. Antennules with only one seta on inner margin of last joint of peduncle. Antennal scale subrhomboidal, rather narrow, of nearly equal breadth throughout, not quite reaching the end of peduncle of antennules, its extremity extending considerably beyond the spine of external margin. Peræopods slender, the finger very slender, its first joint longer in its lesser (that is front) length than broad; second joint or nail very slender and delicate, only slightly bent. Telson terminating in three spinules of equal length and two setæ between the distal lateral spines; sides of telson having three or four spines at base, separated by an interval from those which follow; on the distal portion three to five smaller spines occupying the intervals between the larger spines. Uropods wider than in *crassipes*, the outer with ten to twelve spines on exterior margin of first joint; second joint broader in proportion than in *crassipes*, half as long again as broad. Inner uropods with spines throughout entire length of inner margin to the otolith, but not so crowded towards the base as in *crassipes*; smaller spines alternating with the larger on upper portion, but the four or five most distal spines without smaller intermediates.

Tarbert, Loch Fyne, April 1886 (*Scotch Fishery Board Laboratory*).

Goletta, Cagliari, Syracuse, Messina, and Spezzia, in the Mediterranean (*G. O. Sars*).

[Dec. 15, 1886.—Since received by me from Trieste (*Dr. Koelbel*).]

The distinguishing characters of *S. Clausii* are the single seta on inner margin of last joint of peduncle of antennules, the slender legs and claws, and three equal-sized spinules between the ultimate spines of the telson.

Siriella norvegica, G. O. Sars.

Siriella norvegica, G. O. Sars, Untersog. over Christianiafjordens Dybvandsfauna, 1869, p. 30; Monog. over de ved Norges Kyster forekommende Mysider, 1879, p. 24, pls. xvii. and xviii.

Very like the last in general characters and in rostrum,

antennal scale, peræopods, &c.; but it attains a larger size, 19 millim. as against 10 millim. The following are points of distinction:—Last joint of peduncle of antennules with three setæ on inner margin; antennal scales perhaps rather longer, reaching end of peduncle of antennules, and rather wider in the middle than towards extremity. General character of telson as in last species, but the extremity having a central small spinule, flanked on each side by a still more minute spinule and pair of setæ between the ultimate spines. Outer uropods with seventeen to twenty-five spines on outer margin of first joint. Inner uropods with smaller spines alternating with larger throughout the inner margin, except between the last and penultimate spines.

Norway, Christiania Fiord and west coast (*G. O. Sars*); Lervig, Hardanger Fiord (*A. M. N.*).

Siriella norvegica has not as yet been found on our coast, but may be expected to occur. Its characters are given here, as well as those of the next species, for comparison with their very close allies.

Siriella crassipes, G. O. Sars.

? *Cynthia Flemingii*, H. Goodsir, Bell, British Stalk-eyed Crustacea 1853, p. 379 (mas).

Siriella crassipes, G. O. Sars, Middelhavets Mysider, 1876, p. 89, pl. xxxii.

In general characters very near the two preceding species, but the whole form is somewhat more robust in proportion to size, and the legs are much stronger. The following will supply diagnostic characters.

Antennules with three setæ on inner margin of third joint of peduncle. Antennal scale less parallel-sided than in *Clausii*, widening slightly about the middle, as in *norvegica*. Peræopods stout and strongly built, the joints more flattened and wider in proportion to their length than in the two preceding species; finger with first joint not longer in lesser (front) length than broad, second joint or nail strong and well curved. Telson terminating in a small spinule, flanked on each side by the usual setæ, and a more minute spinule between the ultimate pair of spines; three or four basal spines of lateral margin, as usual, separated by an interval from following spines; on hinder portion two to six smaller spines (varying in number according to size of specimen) in the intervals between the larger spines. Uropods narrow; outer with nine to twelve spines on external margin of basal joints, terminal joint twice as long as broad. Inner uropods with smaller spines alternating with the larger on the upper half

of inner margin, but eight or more distal spines without such smaller spines between them.

This species has been known to me as a member of our fauna for the last twenty-five years, at which time I found it at Cullercoats, Northumberland. Specimens are also in my collection from Banff (*T. Edward*); Starcross, Devon (*C. Parker*, 1883); Jersey (*Sinel and Co.*, 1884).

It is recorded in 'The Life of a Scotch Naturalist' under the name *Mysis aculeata*, a MS. name by which I had called the female when first found.

Cynthia Flemingii, Goodsir, is a male of this genus, and most probably of this species; but it is impossible to identify it with any degree of certainty from the description given.

In the Mediterranean this species was found by Sars in company with *S. Clausii* at Goletta.

[Dec. 15, 1886.—Since received by me from St. Andrews (*Dr. M'Intosh*).]

Siriella Brooki, Norman, n. sp.

Very like the three species which have just been described. The rostrum is shorter and bent downwards at the extremity. The antennules have one seta on inner margin of last joint of peduncle. The peræopods are intermediate in thickness between those of *Clausii* and *crassipes*, the finger strong, the first joint not longer in its lesser (front) length than its breadth, second joint or nail strong and well curved. Telson terminating in a small spinule, flanked on each side by the usual setæ, and a very minute spinule between the ultimate spines. Uropods narrow, outer pair with ten to twelve spines on exterior margin of first joint; terminal joint twice as long as broad. Inner uropod with seven or more distal spines of interior margin without smaller intermediate spines, and even above these they only become decidedly smaller by degrees. Colour of specimens, which had been a few days in spirit, white, the eyestalks and peduncles of antennæ suffused with yellow; telson and uropods more or less stained with yellow or pink. Length from the end of antennal scale to extremity of uropod rather more than half an inch, or 14 millim. About a dozen specimens, including both sexes, examined.

Very near to *crassipes*, from which it differs in being more slender in general form, with less strong peræopods, and a single seta only on inner margin of ultimate joint of peduncle of antennules.

Possibly it may prove to be a variety of *crassipes*; but more extended observation is necessary to clear up this point.

With regard to the number of setæ on inner side of last

joint of peduncle of antennules, I may mention that in some specimens of *S. crassipes* I have not been able to make out more than two, and in one specimen of *S. Brooki* the left antennule has a second seta, while the right bears as usual one.

S. Brooki has been found at Tarbert, Loch Fyne, by the Fishery Board, in company sometimes with *S. Clausii.* I have named the species after Mr. G. Brook.

Siriella armata (M.-Edw.).

Cynthia armata, M.-Edw. Hist. Nat. d. Crust. ii. p. 463 (mas, *fide* G. O. Sars).
Mysis Griffithsiæ, Bell, Hist. Brit. Crust. p. 342.
Mysis rostratus, Guérin, Iconog. Crust. pl. xxiii. fig. 3 (probably).
Siriella armata, G. O. Sars, Middelhavets Mysider, 1876, p. 96, pl. xxxv.

Animal very long and slender. Rostrum of great size, the extremity very acute and reaching the end of the second joint of the peduncle of the antennules. Antennal scale long and narrow, not quite so long as peduncle of antennules. Peræopods slender. Telson terminating usually in four equal-sized spinules and two setæ between the ultimate spines. Wide intervals between the larger spines of lateral margin, these intervals occupied by six to ten smaller crowded spines of nearly equal size. Uropods very long and unusually narrow; outer bearing very numerous (twenty-five to thirty) spines on external margin, second joint about one third to one half longer than broad. Inner margin of inner uropods with numerous spines, gradually increasing in length distally, and without admixture of smaller spines. Length $\frac{3}{4}$ inch, or 20 millim. The branchial appendage (?) of the second and following pleopods in the male is completely coiled.

The greatly developed rostrum at once distinguishes this species from the other British representatives of the genus; but another form from the Mediterranean, *Siriella frontalis,* M.-Edw., bears a close general resemblance, but the branchial appendages of the pleopods of male are wholly different and not coiled, and on this ground Claus has instituted a new genus—*Pseudosiriella*—for its reception *. There are three spinules at the termination of the telson in this species, and as many as fifteen smaller spines are in the intervals between the larger spines on the sides of the telson.

* *Pseudosiriella frontalis,* M.-Edw., is also a member of the British fauna. I have a drawing made many years ago, at a time when I had no other Crustacea than British, which undoubtedly represents the female of this species; but unfortunately no locality is under the drawing. The specimen was probably one sent to me for examination.

I have examined specimens of this species from Firth of Clyde, 1865 (*D. Robertson*); Starcross, Devon, 1884 (*C. Parker*); Jersey, 1884 (*Sinel and Co.*); Tarbert, Loch Fyne, 1885 (*Scotch Fishery Laboratory*); and unmistakable drawings have been sent to me of specimens taken at Plymouth (*Spence Bate*), and Castleton, Isle of Man (*G. S. Brady*). It has been recorded from Torquay (*Griffiths*) and Weymouth (*Wm. Thompson*). Milne-Edwards's type was from "Noirmoutiers," and Sars took it in the Gulf of Goletta.

[Dec. 15, 1886.—Since received from St. Andrews (*Prof. M'Intosh*) and Trieste (*Dr. Koelbel*).]

Order CUMACEA.

Genus Lamprops, G. O. Sars.

Lamprops fasciata, G. O. Sars.

Lamprops fasciata, G. O. Sars, Om en i Sommeren 1862 foretagen Zoologisk Reise i Christianias og Trondhjems Stifter, 1863, p. 44; "Om den aberrante krebsdyrgruppe Cumacea" (Vid. Selsk. Forhandl. 1864), p. 66.

First sent to me as British by Mr. David Robertson, who found it at Helensburgh, in the Firth of Clyde; and (March 1886) taken by the Fishery Board Laboratory among sand at low water, Tarbert, Loch Fyne.

"Habitat rara in sinu Nidrosiensi prope urbem Stenkjær in prof. 12–20 orgyarum, adque insulas Lofotenses, ubi unicum inveni exemplar" (*G. O. Sars*).

It may at once be known from the other described species of the genus by three oblique folds which are present down the sides of the carapace.

The above is the only species of the genus as yet known in the British sea. Other closely allied forms which were included in this genus have recently been separated by Sars under the name *Hemilamprops*. Of this restricted genus we have in Britain the following representatives. *Hemilamprops* is a MS. genus of G. O. Sars, which he has not yet defined.

Hemilamprops rosea (Norman).

Vaunthompsonia rosea, Norman, Trans. Tyneside Nat. Field-Club, v. (1862), p. 271, pl. xiii. figs. 1–3, ♀.
Cyrianassa elegans, Norman, *loc. cit.* p. 275, pl. xiv. figs. 1–6, ♂.
Lamprops rosea, G. O. Sars, "Om den aberrante krebsdyrgruppe Cumacea" (Vid. Selsk. Forhandl. 1864), p. 64.
Hemilamprops rosea, G. O. Sars, "Oversigt af Norges Crustaceer" (Christ. Vidensk. Forhandl. 1882), p. 11.

Fifty to one hundred miles east of Tynemouth, Northum-

berland (*A. M. N.*); Lough Foyle, Ireland, 15 fathoms (*'Porcupine' Expedition*).

In Norway I have dredged it at Drobak, in the Christiania Fiord, and off Lervig, in the Hardanger Fiord; also at Floro. Sars has found it as far north as the Lofoten Islands.

Hemilamprops cristata, G. O. Sars.

Lamprops cristata, G. O. Sars, "Nye Dybvandscrustaceer fra Lofoten" (Vid. Selsk. Forhandl. 1869), p. 13.

Lamprops cristata, Norman, "Crustacea Cumacea of the 'Lightning,' 'Porcupine,' and 'Valorous' Expeditions," Ann. & Mag. Nat. Hist. ser. 5, vol. iii. 1879, p. 68.

Hemilamprops cristata, G. O. Sars, "Oversigt af Norges Crustaceer" (Christ. Vidensk. Forhandl. 1862), p. 11.

Firth of Clyde, 1860 (*Mr. D. Robertson*); south of Rockall, lat. 56° 7′ N., long. 14° 19′ W., 630 fathoms (*'Porcupine,'* 1869).

On the Norwegian coast I have taken it in 150 to 180 fathoms, off Midtö lighthouse, and in Stoksund, 80 to 100 fathoms, both in the Hardanger Fiord.

Sars has also dredged it in the Hardanger Fiord off the island of Husö, 100 to 105 fathoms, and at Lofoten in 120 to 200 fathoms.

There are six European species belonging to these two genera. The genera are distinguished from all other Cumacea by having a well-developed, long, flattened, linguiform telson, which is broad at the extremity and terminates in several spines; the carapace is small, the first three pairs of feet have fully developed natatory palps, and the two following pairs two-jointed rudimentary palps. In the male the antennules have a bunch of cilia at the extremity of the peduncle, and the pleon is furnished with three pairs of natatory feet.

The following more salient features will enable the species to be separated. It is probable that more of these forms await discovery in our own seas.

Lamprops fasciata, G. O. Sars. Carapace with three well-developed oblique folds on the sides. Telson with one or two pairs of lateral spines, and terminating in five spines.—Britain, Norway.

Lamprops fuscata, G. O. Sars. Carapace smooth, rostrum acutely produced. Telson with one or two pairs of lateral spines, terminating in five spines.—Norway.

Hemilamprops rosea (Norman). Carapace smooth, rostrum not produced, the front forming nearly a right angle. Eyes well developed. Telson not much contracted towards the extremity, with one or two pairs of lateral spines, and termina-

ting in seven or eight spines. Animal more or less stained with a rich rose colour.—Britain, Norway.

Hemilamprops assimilis, G. O. Sars. Carapace and rostrum nearly as in the last; eyes rudimentary. Telson suddenly contracted near the extremity, with one pair of lateral spines, and terminating in six spines. Integuments very delicate. Animal without colour.—Finmark.

Hemilamprops uniplicata, G. O. Sars. Carapace with one oblique fold on the sides. Telson with four or five pairs of lateral spines, and terminating in three spines.—Norway.

Hemilamprops cristata, G. O. Sars. Carapace having the anterior half of the dorsal line denticulately serrated. Telson with two or three pairs of lateral spines, and terminating in three spines.—Britain, Norway.

The males in all cases have the carapace smooth, and therefore present greater difficulties in determination than the females, to which the above characters, as regards the carapace, refer. To determine the males it will be necessary to refer to the full description given by Sars of the species.

Genus Diastylis, Say.

Diastylis rugosa, G. O. Sars.

Diastylis rugosa, G. O. Sars, "Om den aberrante Krebsdyrgruppe Cumacea og dens nordiske Arter" (Vid. Selsk. Forhandl. 1864), p. 41; Nye Bidrag til kundskaben om Middelhavets Invertebratfauna, II. Middelhavets Cumaceer, 1879, p. 98, pls. xxxiv.–xxxviii.

Diastylis strigata, Norman, "Cumacea of the 'Lightning,' 'Porcupine,' and 'Valorous' Expeditions," Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 62 (mas adultus).

The Fishery Board has found specimens of this species at Tarbert, Loch Fyne.

Its known distribution is Christiania Fiord, 10 to 12 fathoms; Christiansund; Utne, Hardanger Fiord, 30 to 50 fathoms (*G. O. Sars*); Denmark; West France; Syracuse, Messina, and Naples, in Mediterranean (*G. O. Sars*).

Valentia harbour, Ireland, female, and off Valentia, townet, 1870 (*A. M. N.*); Lough Swilly, County Donegal, in 15 fathoms ('*Porcupine*' *Exped.* 1869); Drobak, Christiania Fiord, 1879, and Lervig, Hardanger Fiord, 1878, Norway (*A. M. N.*).

Genus Pseudocuma, G. O. Sars.

Pseudocuma cercaria (Van Beneden).

Leucon cercaria, Van Beneden, Recherches sur la Faune littorale de Belgique, Crustacés, 1860, p. 85, pl. xiv.

Pseudocuma bistriata, G. O. Sars, "Om den aberrante Krebsdyrgruppe Cumaceer" (Vid. Selsk. Forhandl. 1864), p. 70.
? *Cyrianassa longicornis*, Spence Bate, Nat. Hist. Review, vol. v. 1858, p. 203.
Cuma bella, Meinert, "Crust. Isop. Amphip. et Decapoda Daniæ" (Naturhist. Tidssk. 3 R. 11 B. 1877), p. 179.
Cuma cercaria, Meinert, "Crust. Isop. Amphip. et Decapoda Daniæ" (Naturhist. Tidssk. 3 R. 12 B. 1880), p. 497.
Pseudocuma cercaria, G. O. Sars, Middelhavets Cumaceer, 1879, p. 114, pls. xl.–xlii.

This small species seems to be the most numerically abundant of the Cumacea in the British seas. Its distribution is as follows:—

Belgium (*Van Beneden*); Denmark (*Meinert*); Norway, from Christiania to the Lofoten Islands (*G. O. Sars*); Mediterranean, at Goletta, Messina, and Syracuse (*G. O. Sars*).

I can myself testify to the following localities:—Whitby, Yorkshire, and Seaton Carew, County Durham (*A. M. N.*); Sunderland (*G. S. Brady*); Cumbrae, Firth of Clyde (*D. Robertson*); Tarbert, Loch Fyne (*Fishery Board Laboratory*); Naples (*Zool. Stat.*).

It is a shallow-water form, found on a sandy bottom, usually in 0–10 fathoms. Now first recorded as British.

XII.—*Description of a new Butterfly allied to* Vanessa antiopa. By Arthur G. Butler, F.L.S., F.Z.S., &c.

For some years past I have held the view that what is generally understood by the term species (that is to say, a well-defined, distinct, and constant type, having no near allies) is non-existent in the Lepidoptera, and that the nearest approach to it in this order is a constant, though but slightly differing, race or local form—that genera, in fact, consist wholly of a gradational series of such forms.

In opposition to this view certain "species" are cited as isolated, or in no way united by existing intergrades to their nearest allies, from which, moreover, they show such wide differences that the existence of intergrades is regarded as highly improbable. One of the best known and, at the same time, widely distributed of these apparently isolated species is *Vanessa antiopa*, which, although slightly modified locally in size and tint (the Central-American form being usually smaller and the North-American larger and more heavily speckled than the European type), yet has no described allies

nearer than the blue-belted *V. glauconia*, *charonia*, and *haronica*.

The forms differing from the type of *V. antiopa*—*V. hygiœa*, from Europe, and *V. Lintneri*, from the United States —are regarded, with every likelihood of being right, as aberrations of that species; judging from Hübner's figure (lettered "*antiopa*") and Fitch's description, these aberrations appear to be very similar, differing chiefly from the normal form in the absence of many of the blue spots and the slightly wider yellow border of all the wings.

The following form is less likely to be a variety of *V. antiopa* than the others, since the modification of the border is not uniform and at the same time is far more remarkable; it was obtained by the Hon. Walter De Rothschild from a collection of Lepidoptera chiefly from British Honduras, but with which the collector had carelessly placed species obtained in British Guiana. At the same time, as the small form of the allied *V. antiopa* occurs in Mexico and Guatemala, it is more probable that the former locality is the correct one than the latter.

Vanessa Thomsonii, n. sp.

Colouring darker than in *V. antiopa*; primaries with pale straw-coloured outer border, about as wide as in that species, but heavily mottled with black, especially upon the veins; a subapical oblique yellow spot followed by five smaller decreasing and less distinct spots of the same colour, but followed by whitish scales, the whole forming an elbowed series; costa speckled with yellowish in the centre: secondaries with the basal three fifths of the same dark dull chocolate-brown as the primaries, the external two fifths, which are separated by a sharply defined, regularly dentate-sinuate line from costa to anal angle, straw-yellow, rather heavily mottled with black, but densely so upon the tail. Below, the general colouring is sericeous dark grey-brown, rather browner on the primaries than on the secondaries, striated throughout with intense black; the borders of the wings are broadly paler, of more equal width than above, bounded internally by two or three white points, and mottled with white; the fringe ochreous, interrupted by the black veins. Expanse of wings 67 millim.

British Honduras? (*coll. Hon. W. De Rothschild*).

It will be seen that the outer border of the secondaries in this insect is twice the width of that of the primaries.

XIII.—*New Genera and Species of* Corylophidæ *in the Collection of the British Museum.* By the Rev. A. Matthews.

Through the kindness of Dr. Günther and Mr. Waterhouse I have been enabled to examine the collection of unnamed Corylophidæ contained in the British Museum, an accumulation from various parts of the world, but chiefly the results of the explorations of Messrs. Bowring and Thwaites in the tract extending from the north of China to Borneo and the other islands of the Malayan archipelago. As might have been expected, I have found these insects of the most novel and interesting description, exhibiting strange forms of unknown genera, and some yet stranger and more abnormal species of genera already discovered. The following list will prove both the richness and the novelty of this collection :—

New Species.

Sacium imperiale.
—— alutaceum.
Arthrolips rotundatus.
—— suffusus.
—— bimaculatus.
—— senegalensis.
—— croceus.
—— semipunctatus.
—— flavicollis.
—— elegans.
Sericoderus crassus.
—— australis.
Peltinus orientalis.
Corylophodes glabratus.
—— unicolor.
—— insignis.
Oligarthrum Waterhousii.
Catoptyx Bowringii.
Lepadodes chilensis.
Aphanocephalus impunctatus.
—— quadrimaculatus.
—— vitreus.
—— dissimilis.

There are also examples of other rare species, such as *Rhypobius velox*, *Anisomeristes castaneus*, and *Aphanocephalus Wollastoni.*

In the present descriptions I shall mention such characters only as will suffice for the recognition of the new genera and species.

Sacium imperiale, sp. nov.

Long. 2·30, lat. 1·50 mm. Ovatum, latissimum, modice convexum, nitidulum, modice et sat confertim punctatum, pilis brevibus aureis vestitum, castaneum; pronoto antice circulariter rotundato, modice reflexo, et rufescente; elytris castaneis, macula humerali, macula magna aquiliformi dorsali atque marginibus læte rufis; pedibus longis, gracilibus, læte flavis; antennis longis, gracilibus, articulis duobus apicalibus læte flavis, cæteris obscurioribus.

This fine species is remarkable for its great size and breadth, and for the variegation of its colour. At first sight it would appear to belong to a distinct genus, but since the organs of its mouth and the arrangement of the skeleton of the

underside correspond with the normal type of *Sacium*, I feel no hesitation in placing it in that genus. It was found in Mysol by Mr. Wallace.

Sacium alutaceum, sp. nov.

Long. 1 mm. Oblongo-ovale, modice convexum, sat profunde punctatum, totum alutaceum, pilis aureis sparse vestitum, pronoto rufescente, elytris piceis; pronoto sat longo, antice ovaliter rotundato et fortiter reflexo; elytris pronoto vix latioribus, duplo longioribus, ad humeros latissimis; pedibus robustis, læte flavis; antennis modicis, flavis.

S. alutaceum resembles in form the normal species of *Sacium*, from which it is distinguished chiefly by the deeply alutaceous sculpture of its upper surface.

Found near Maldonado, in South America.

Arthrolips rotundatus, sp. nov.

Long. 1·50, lat. 1 mm. Ovatus, latissimus, modice convexus, profunde punctatus, rufo-testaceus, pilis flavis dense vestitus; pronoto magno, antice circulariter rotundato et modice reflexo, sat profunde punctato; elytris pronoto parum latioribus, plus quam sesquilongioribus, et magis leviter punctatis, prope humeros latissimis, postice angustatis; pygidio longius exserto, rufo-testaceo; pedibus modicis, flavis; antennis brevibus, robustis, flavis.

Like *Sacium imperiale* this species has a most abnormal appearance. In outward form it exhibits no affinity to *Arthrolips*, although in the whole of its anatomy it perfectly accords with that genus.

Two specimens were found by Mr. Bowring in Borneo.

Arthrolips suffusus, sp. nov.

Long. 1·35 mm. Late ovalis, convexus, nitidus, pilis aureis sat dense vestitus, obscure castaneus; pronoto rufescente et vitta suffusa, læte rufa in disco elytri utriusque; pronoto magno, antice fere circulariter rotundato et levissime reflexo, levissime punctato; elytris pronoto haud latioribus, duplo longioribus, ad humeros latissimis, profunde punctatis, vitta lata, suffusa, rufa, in utroque notatis; pedibus robustis atque antennis læte flavis.

Found in China by Mr. Bowring.

Arthrolips bimaculatus, sp. nov.

Long. 1·25 mm. Late ovalis, valde convexus, nitidulus, modice punctatus, pilis flavescentibus sat dense vestitus, piceus, margine anteriore pronoti rufescente, atque macula magna ovali læte rufa in elytro utroque, notatus; pronoto magno, lato, antice circulariter rotundato, modice reflexo et læte rufescente, confertim punctato; elytris pronoto haud latioribus, vix sesquilongior-

ibus, ad humeros latissimis, confertim et profunde punctatis, piceis, macula magna ovali pone media læte rufa; pedibus atque antennis flavis, clavis rufescentibus.

Of this conspicuous species there is a single example in the British Museum, found in Burmah by Mr. Bowring.

Arthrolips senegalensis, sp. nov.

Long. 1·12 mm. Oblongo-ovalis, sat angustus, valde convexus, nitidus, pilis aureis sat longis vestitus, rufescens, elytris pone humeros fasciatim obscuratis; pronoto sat parvo, rufescente, antice ovaliter rotundato et modice reflexo, levissime punctato; elytris pronoto vix latioribus, plus quam duplo longioribus, prope humeros latissimis, rufescentibus, pone humeros fasciatim obscuratis, postice profunde punctatis; pygidio rufescente; pedibus robustis, læte flavis; antennis parvis, gracilibus, flavis.

One specimen only, found in Senegal.

Arthrolips croceus, sp. nov.

Long. 1·10 mm. Ovalis, convexus, minute punctatus, flavus, pilis brevibus aureis dense vestitus; pronoto sat magno, antice fere circulariter rotundato et sat late reflexo, minute punctato, nitidissimo; elytris pronoto haud latioribus, sesquilongioribus, prope humeros latissimis, confertim punctatis, apicibus angustatis; pedibus atque antennis læte flavis.

This species may be known by its bright yellow colour and short pubescence. It was found in Siam by Mr. Bowring.

Arthrolips semipunctatus, sp. nov.

Long. 0·85 mm. Ovatus, modice convexus, nitidissimus, pronoto modice, elytris profunde et remote punctatis, totus rufo-testaceus; pronoto sat parvo, antice ovaliter rotundato et modice reflexo; elytris pronoto parum latioribus, duplo longioribus, profunde et valde remote punctatis, ad media latissimis; pedibus modicis, læte flavis; antennis brevibus, obscuris.

This species, which was found in Java by Mr. Bowring, and in Ceylon by Mr. Thwaites, may be known from others by its small size and the deep and very remote sculpture of its elytra.

Arthrolips flavicollis, sp. nov.

Long. 0·70 mm. Ovalis, modice convexus, nitidulus, leviter et confertissime punctatus, testaceus, pronoto læte flavo; pronoto parvo, brevi, antice ovaliter rotundato et modice reflexo, minute et confertissime punctato; elytris pronoto latioribus, et plus quam duplo longioribus, ad media latissimis, confertissime punctatis; pygidio flavo; pedibus atque antennis læte flavis, clavis obscurioribus.

Differs from the preceding species in its much smaller size and very fine and close sculpture.

Found in Java by Mr. Bowring.

Arthrolips elegans, sp. nov.

Long. 1·40 mm. Ovalis, latus, convexus, minutissime punctatus, haud nitidus, totus læte flavus, pilis brevibus aureis dense vestitus; pronoto sat magno, antice ovaliter rotundato et modice reflexo, minute et confertissime punctato, angulis posterioribus acutis; elytris pronoto parum latioribus, duplo longioribus, prope media latissimis, minute et confertissime punctatis, apicibus minime rotundatis; antennis brevibus, atque pedibus læte flavis.

On account of its large size and very broad form this fine species should be placed immediately after *A. rotundatus*, from which it differs in its perfectly oval shape, very fine sculpture, and short close pubescence. From all others it is distinguished by its broad form and large size.

One specimen only, found in Africa, but the locality is not mentioned.

Sericoderus crassus, sp. nov.

Long. 1 mm. Brevis, latus, postice attenuatus, convexus, nitidus, pilis brevissimis aureis vestitus, castaneus; pronoto modico, antice ovaliter rotundato, fere impunctato, nitidissimo, margine basali sinuata, angulis acutis longe productis; elytris pronoto haud latioribus, sesquilongioribus, ad humeros latissimis, confertim non profunde asperatis, stria suturali distincta, lateribus rectis, marginatis, apicibus latis, rotundatis; pedibus atque antennis sat brevibus, flavis, harum articulo sexto valde incrassato.

Differs from *S. lateralis* in its shorter and broader form, finer sculpture, and in the enlargement of the sixth joint of the antennæ.

Found in Chili.

Sericoderus australis, sp. nov.

Long. 1 mm. Suboblongus, brevis, convexus, nitidus, pilis brevibus flavis dense vestitus, pronoto aurantiaco, elytris piceo-castaneis; pronoto modico, antice ovaliter rotundato et modice reflexo, indistincte et remote punctato, angulis posterioribus longe productis; elytris pronoto haud latioribus, plus quam sesquilongioribus, ad humeros latissimis, profunde asperatis, obscure castaneis; pedibus modicis, læte flavis; antennis robustis, obscure flavis, articulis 4° et 6° incrassatis.

This species differs from *S. lateralis* in its shorter and broader form and robust antennæ, of which the fourth and sixth joints are much enlarged.

Found near Hobart Town, in Tasmania.

Peltinus orientalis, sp. nov.

Long. 0·75 mm. Late ovalis, validissime convexus, nitidissimus, confertim sed indistincte punctatus, piceus, margine anteriore pronoti anguste flava; pronoto sat magno, antice circulariter rotundato et reflexo, fere glabro, rufo-piceo, margine anteriore flava, margine basali fere recta, angulis rectis; elytris pronoto vix latioribus, duplo longioribus, prope humeros latissimis, confertim et indistincte punctatis, lateribus marginatis, apice obtuso; pedibus atque antennis modicis, flavescentibus.

P. orientalis differs from the other species of *Peltinus* in its dark colour and the yellow margin of its thorax.

A single specimen was found in Java by Mr. Bowring.

Corylophodes glabratus, sp. nov.

Long. 1·50 mm. Subhemisphæricus, postice sat attenuatus, nitidissimus, indistincte alutaceus, fere glaber, aterrimus, margine anteriore pronoti pellucide alba; pronoto sat parvo, antice circulariter rotundato et reflexo, margine anteriore anguste pellucide alba, margine basali fortiter sinuata, angulis obtusis; elytris pronoto latioribus, plus quam duplo longioribus, ante media latissimis, postice parum attenuatis, lateribus marginatis, apicibus leviter rotundatis; pedibus modicis, flavis, femoribus obscuratis; antennis sat longis, flavescentibus, articulis 3° et 5° elongatis.

Differs from other species in its large size, smooth surface, and peculiar antennæ.

One specimen found near Rio Janeiro.

Corylophodes unicolor, sp. nov.

Long. 1·35 mm. Subhemisphæricus, nitidissimus, remote sed distincte punctatus, totus rufo-castaneus; pronoto sat magno, sat profunde punctato, antice ovaliter rotundato et modice reflexo, margine basali fere recta, angulis acutis; elytris pronoto sat latioribus, duplo longioribus et minus profunde punctatis, ad media latissimis, lateribus leviter marginatis, apicibus parum rotundatis; pedibus modicis, rufo-testaceis; antennis modicis, obscure testaceis, articulo apicali pallido.

This species may be known by its uniform castaneous colour and the acute posterior angles of its thorax.

Found in Java by Mr. Bowring.

Corylophodes insignis, sp. nov.

Long. 1·40 mm. Late ovatus, convexus, nitidissimus, glaberrimus, fere impunctatus, aterrimus, dimidio anteriore pronoti læte flavo; pronoto sat parvo, antice fere circulariter rotundato et modice reflexo, dimidio anteriore læte flavo, posteriore aterrimo, margine posteriore scutellum versus producta, angulis sat acutis; elytris

longis, pronoto latioribus et plus quam duplo longioribus, prope media latissimis, aterrimis, glabris et nitidissimis, lateribus leviter marginatis, epipleuris flavis, apice parum acuminato; pedibus sat longis, læte flavis; antennis flavescentibus, clavis brevibus, valde incrassatis, nigrescentibus.

Exempla nonnulla minora et dilutiora sunt, forsan fœminea.

In the size and shape of the club of its antennæ this species differs very much from any other of the genus, and may also be recognized by its ovate form and very peculiar colour.

It was found in Chili.

OLIGARTHRUM*, gen. nov.

Corpus ovale, convexum.

Caput modicum, sub pronoto totum occultum; oculis sat magnis, prominentibus; antennis prope oculos insertis.

Antennæ articulis octo compositæ: 1° sat magno, pyriformi, modice recurvato; 2° gracili atque brevi; 3° secundo parum longiore et latiore; 4° tertio fere duplo longiore et latiore; 5° perbrevi, transverso; 6°–8^m valde incrassatis, clavam subfoliatam formantibus.

Pronotum magnum, margine anteriore integra, valde rotundata.

Elytra integra, sat longa, obtusa.

Prosternum parvum, inter coxas elevatum et postice dilatatum, epimeris sat magnis, receptacula coxarum partim cingentibus; receptaculis coxarum antice et postice partim apertis.

Mesosternum breve, epimeris angustis, a receptaculis coxarum remotis.

Metasternum modicum, transversum, a corporis lateribus remotum, episternis magnis.

Venter segmentis sex compositus, primo magno.

Pedès antici tibiis prælongis, incurvatis; *intermedii* anticis breviores, tibiis simplicibus; *postici* intermediis longiores.

Coxæ anteriores magnæ, ovales, prominentes, prosterno elevato divisæ; *intermediæ* magnæ, rotundatæ, modice distantes; *posteriores* sat parvæ, subovatæ, sat remotæ.

Tarsi omnes 4-articulati, articulo tertio exiguo.

I did not venture to dissect the mouth of the unique specimen on which this genus is founded, and therefore cannot describe its palpi; but from superficial examination they appear to be of the usual *Corylophide*-type. The genus is, however, sufficiently distinguished by its peculiarly formed eight-jointed antennæ and other anatomical characters.

Oligarthrum Waterhousii, sp. nov.

Long. 0·75 mm. Ovale, valde convexum, nitidum, sat profunde punctatum, totum castaneum; pronoto magno, antice ovaliter rotundato et modice reflexo, indistincte punctato; margine basali

* ὀλίγος, few; ἄρθρον, a joint.

leviter sinuata, angulis acutis; elytris pronoto sesquilongioribus, haud latioribus, ad humeros latissimis, sat profunde punctatis, lateribus leviter marginatis, apice obtuso; pygidio minime exserto; pedibus atque antennis rufo-testaceis.

I feel much pleasure in naming this remarkable species after Mr. C. O. Waterhouse, in return for the valuable assistance I have often received from him. The unique example in the collection of the British Museum was found in Chili.

CATOPTYX *, gen. nov.

Corpus subhemisphæricum, antice circulariter rotundatum, postice parum acuminatum.

Caput modicum, sub pronoto totum occultum, ore deflexo, elongato, et valde acuminato; oculis sat parvis, prominentibus; antennis juxta oculos insertis.

Antennæ 11-articulatæ: 1° permagno, pyriformi, fortiter recurvato, externe late deplanato; 2° sat parvo, fere ovali; 3°–6m minutis; 7° interne valde incrassato, quatuor præcedentibus fere æquali; 8° parvo; 9°–11m magnis, valde incrassatis, clavam foliatam formantibus.

Palpi maxillares permagni, 4-articulati: 1° parvo; 2° permagno, incurvato, valde incrassato; 3° brevissimo, transverso; 4° truncato-conico, tertio graciliore et parum longiore.

Palpi labiales sat magni, triarticulati: 1° exiguo; 2° permagno, ovali, longe infra primum producto; 3° parvo, ad apicem valde dilatato, abrupte truncato et setis sat longis fimbriato.

Labrum elongato-triangulare, setis instructum.

Mandibulæ longæ, graciles, sublineares, ad apicem bifidæ atque ungue acuto terminatæ.

Maxillæ sat magnæ, unilobatæ, lobo lato, cultriformi, ad apicem acuto, acie interna acute et remote serrata.

Mentum sat parvum, subquadratum.

Labium breve, ad basim dilatatum, lateraliter rotundatum.

Lingua sat parva, semiovata, pellucida atque eleganter undulata.

Pronotum magnum, margine anteriore integra, nihilominus *angulis quasi anterioribus subtus abrupte inflexis, atque ad latera capitis arcte aptatis*, angulis posterioribus parum productis.

Elytra integra, magna, latissima, epipleuris latissimis.

Alæ amplæ, pellucidæ.

Prosternum parvum, perbreve, carinatum; epimeris magnis, interne valde elongatis, receptacula coxarum tota postice includentibus: receptaculis coxarum valde elongatis, antice omnino apertis, postice per epimera inclusis.

Mesosternum perbreve, carinatum; epimeris angustis, elongatis, receptacula coxarum non contingentibus; receptaculis coxarum magnis, rotundatis, remotis.

* *κάτω*, below; *πτύσσω*, to fold.

Metasternum magnum, transversum, lateribus corporis remotum; episternis permagnis, latis.

Venter segmentis sex compositus, primo magno, longo.

Pedes antici tibiis ante medias parum dilatatis; tarsis perbrevibus, robustis; *intermedii* anticis brevioribus, tibiis prope medias valde dilatatis, tarsis perbrevibus, robustis, articulis duobus primis valde dilatatis, profunde bilobatis, et setis instructis; *postici* intermediis longiores, tibiis ad medias valde dilatatis; tarsis intermediis similibus.

Tarsi omnes 4-articulati, articulo tertio exiguo.

Coxæ anteriores valde elongatæ, prominentes, et fere contingentes; *intermediæ* rotundatæ, sat remotæ; *posteriores* magnæ, subtriangulares, ad episterna extensæ, late remotæ.

This interesting genus is distinguished from others by the remarkable inflection of the anterior angles of its thorax, the elongate and acuminate anterior portion of its head, the linear and bifid mandibles, the compressed and dilated tibiæ, and short dilated tarsi of its four posterior legs.

Catoptyx Bowringii, sp. nov.

Long. 1·70 mm., lat. 1·30 mm. Subhemisphæricus, postice sat attenuatus, nitidissimus, profunde punctatus, niger, margine anteriore pronoti læte flava, atque disco pronoti et vitta lata in elytro singulo læte kermesinis; pronoto sat brevi, antice circulariter rotundato et reflexo, margine anteriore læte flava, disco læte kermesino, angulis posterioribus acutis; elytris pronoto sesquilongioribus, parum latioribus, prope humeros latissimis, profunde punctatis, vitta lata, suffusa, læte kermesina in utroque ornatis; pygidio exserto; pedibus atque antennis rufescentibus.

Exempla nonnulla (fœminea?) colorem plus minusve castaneum habent.

I have named this conspicuous insect in honour of Mr. Bowring, by whose exertions the greater part of the species described in these pages were discovered. *C. Bowringii* varies much in size and colour; the larger individuals exhibit the beautiful colours given in the foregoing description, while the smaller are more or less castaneous; these last are probably females.

Several specimens of both varieties were found in Java.

Lepadodes*, gen. nov.

Corpus omnino ovatum.

Caput parvum, sub pronoto totum occultum; oculis parvis prominulis; antennis juxta oculos insertis.

* λεπὰς, a limpet; εἶδος, likeness.

Antennæ 9-articulatæ: 1° permagno, pyriformi, recurvato; 2° primo vix breviore, multo angustiore; 3° parvo, gracili; 4°–6^m brevibus, sibiipsis paribus; 7°–9^m permagnis, valde incrassatis, clavam foliatam formantibus, apicali oblique truncato.

Palpi maxillares magni, 4-articulati: 1° exiguo; 2° permagno, validissime incrassato, ad apicem oblique truncato; 3° brevi, transverso; 4° sat longo, conico, robusto.

Palpi labiales modici, omnino ovati, triarticulati: 1° exiguo; 2° ovato, ad apicem truncato; 3° perbrevi, obtuse conico.

Labrum modicum, subquadratum, angulis anterioribus rotundatis.

Mandibulæ modicæ, costa dorsali ad apicem bifida firmatæ, dentibus multis, longis, acutissimis apicem versus armatæ.

Maxillæ unilobatæ, lobo sat robusto, ad apicem bifido, atque dentibus multis, incurvatis, gracillimis apicem versus armatæ.

Mentum sat parvum, subquadratum, antice parum dilatatum.

Labium suboblongum, breviter exsertum.

Lingua magna, antice dilatata et rotundata.

Pronotum magnum, margine anteriore integra, posteriore fere recta.

Elÿtra integra, epipleuris modicis.

Prosternum sat magnum, longe carinatum, carina antice et postice producta, antice acuta, postice dilatata; episternis inconspicuis; epimeris sat magnis, receptacula coxarum postice includentibus; receptaculis coxarum ovatis.

Mesosternum breve; episternis magnis, suboblongis; epimeris humeralibus, longis, angustis, curvatis, ad coxas non extensis; receptaculis coxarum rotundatis, longe remotis.

Metasternum magnum, transversum, a corporis lateribus remotum, margine posteriore inter coxas fere recta; episternis permagnis, latis; epimeris sub elytris occultis.

Venter segmentis sex compositus, primo magno, longo.

Pedes sat breves, simplices; tarsis 4-articulatis, tertio minuto; unguibus robustis, subtus longe dentatis.

Coxæ anteriores ovatæ, prominentes, per carinam divisæ; *intermediæ* rotundatæ, longe distantes; *posteriores* modicæ, pyriformes, longe remotæ.

This genus is distinguished from *Corylophus* by the shape of the thorax, in which the posterior angles are not produced; the large size of the prosternum, with the coxal cavities broadly enclosed; the uniform size of the intermediate joints of the antennæ; and the shape of all the organs of the mouth.

Lepadodes chilensis, sp. nov.

Long. 0·80 mm. Ovalis, valde convexus, nitidus, modice et distincte punctatus, pilis brevissimis vestitus, totus castaneus; pronoto magno, antice ovaliter rotundato, reflexo, et rufescente, remote punctato, linea basali sat profunde impressa et distincte punctata, margine basali fere recta, angulis acutis; elytris pronoto vix latioribus, fere sesquilongioribus, prope humeros latissimis, distincte et

sat confertim punctatis, stria suturali distincta, lateribus marginatis, apicibus parum rotundatis et dilutioribus; pedibus atque antennis sat brevibus, flavis.

Two specimens of this neat-looking little insect were found in Chili.

Aphanocephalus impunctatus, sp. nov.

Long. 2·25 mm. Omnino hemisphæricus, impunctatus, nitidissimus, aterrimus, pronoto antice ferrugineo; pronoto parvo, perbrevi, antice levissime excavato, margine anteriore ferruginea, angulis posterioribus obtusis; elytris permagnis, pronoto multum latioribus, et fere triplo longioribus, ad media latissimis, superficie inæquali, indistincte alutacea, lateribus late marginatis, apice latissimo; pedibus piceis, tarsis flavis; antennis sat brevibus, flavis.

Differs from *A. hemisphæricus* in its much larger size and impunctate surface.

A single specimen of this insect was found in Brazil.

Aphanocephalus quadrimaculatus, sp. nov.

Long. 1·60 mm. Obtuse ovalis, validissime convexus, nitidissimus, sat profunde punctatus, pilis flavis sparsissime indutus, pronoto læte rufescente, elytris nigris, maculis quatuor magnis læte rufis ornatis; capite prominenti, rufo-piceo, profunde punctato; pronoto modico, antice leviter excavato, circulariter rotundato et reflexo, sat remote punctato, læte rufescente, angulis posterioribus obtusis; elytris capite atque pronoto vix latioribus, plus quam duplo longioribus, prope media latissimis, confertim et profundissime punctatis, nigris maculis duabus, magnis, læte rufis, utrisque notatis, lateribus late marginatis, apice valde obtuso; pedibus atque antennis sat gracilibus, læte flavis.

This pretty species is readily distinguished by its obtusely oval form and ornamental colour.

Four specimens were found in Penang by Mr. Bowring.

Aphanocephalus vitreus, sp. nov.

Long. 1·35 mm. Omnino ovatus, valde convexus et valde nitidissimus, pronoto minutissime, elytris profunde punctatis, nigrescens, macula magna, suffusa, læte rufa, in elytro utroque notatus; capite valde prominenti, rufescente; pronoto magno, antice sat profunde excavato, minute punctato, lateribus late marginatis, angulis posterioribus acutis; elytris capite atque pronoto vix latioribus, duplo longioribus, ante media latissimis, nigrescentibus, macula magna, suffusa, læte rufa, in disco utriusque notatis, lateribus late marginatis, apice ovato; pygidio parum exserto, rufescente; pedibus atque antennis flavescentibus.

A. vitreus differs from all the other species in its perfectly ovate form, brightly polished surface, and in colour and sculpture.

Found in China by Mr. Bowring.

Aphanocephalus dissimilis, sp. nov.

Long. 1·10 mm. Subovatus, validissime convexus, nitidus, profunde punctatus, æneo-piceus; capite prominenti, magno, lato, indistincte punctato; pronoto sat brevi, transverso, antice excavato, punctis umbilicatis sat confertim impresso, lateribus rotundatis et marginatis, angulis posterioribus sat obtusis; elytris capite atque pronoto parum latioribus, duplo longioribus, ad media latissimis, profundissime punctatis, lateribus late marginatis, apice valde obtuso; pedibus longis, gracilibus, læte flavis; antennis longis, flavescentibus.

Differs from all the other species in the greater prominence of its head and in the size, form, and sculpture of its body.

Many specimens of this insect were found in China by Mr. Bowring.

Aphanocephalus Wollastoni, Rye, was also found in China by Mr. Bowring.

The species of this genus, which appear to be abundant in the countries of the extreme east of Asia, differ so widely from the true Corylophidæ that they evidently belong to an entirely distinct family. In superficial appearance they bear some resemblance to the Corylophidæ; but, except in the large size of the second joint of their palpi, they differ from them in every anatomical character.

Their antennæ are formed on an entirely different plan, and have an apparently solid club, and when at rest or withdrawn for concealment are not folded back upon themselves, as in all the genera of Corylophidæ, but are extended in a straight line underneath the prothorax.

Instead of the unilobed maxilla of the Corylophidæ, *Aphanocephalus* exhibits a maxilla with three distinct lobes, like the Trichopterygidæ, although the outer lobe is not a true lobe, but an integral prolongation of the stipes. Again, in the enormous size of the mesosternal epimera *Aphanocephalus* resembles the Trichopterygidæ; but in the shape and position of the coxal cavities it is equally unlike that family or the Corylophidæ. The tarsi of *Aphanocephalus* are merely three-jointed, without any trace of a short penultimate joint, and its wings are narrow and elongate, and strengthened throughout with strong nervures, unlike the broad, rounded, and almost nerveless wings of the Corylophidæ.

It appears to me that all these characters are quite sufficient to justify the separation of *Aphanocephalus* from the Corylophidæ; and since, for the same reasons, the genus cannot be placed in any other family, it must be regarded as a family distinct in itself, for which I propose the name of Pseudocorylophidæ.

In our present systematic arrangement the true Corylophidæ seem to occupy a very false position. From the peculiar formation of their antennæ, and from their large, elongate, and either entirely free or prominent anterior coxæ, as well as from the general arrangement of the parts of the external skeleton of their underside, it is impossible to overlook their close affinity to the Silphidæ. It therefore appears to me that the most natural arrangement would be to place the Corylophidæ immediately before the Silphidæ. Many genera present an external appearance so like the Anisotomina, that it is difficult at first to determine whether they do or do not belong to that tribe. In *Peltinus* and some others the *prosternum* is reduced to the smallest possible dimensions, as it is in *Agathidium*, and leaves the coxal cavities open on both sides. Thus by placing the Corylophidæ before the Silphidæ, in proximity to the Anisotomina, a much greater harmony of form and anatomy would be attained than by keeping them in their present position or by removing them elsewhere.

In the foregoing remarks I refer only to the true Corylophidæ. Those species which I propose to call Pseudocorylophidæ I would retain in the position they now occupy near the Coccinellidæ.

Gumley,
December 21, 1886.

XIV.—*Description of a new Species of* Distomum. By F. Jeffrey Bell, M.A.

During the dissection of *Halosaurus macrochir*, Dr. Günther discovered in the enlarged ends of the ureters three specimens of a fluke which appears to be undescribed. It may be called

Distomum halosauri.

Body smooth, unarmed, much narrower in front than behind, widening gradually as it passes backwards, no distinct

neck; posteriorly the thin edges are turned over the back. Creamy white in colour. The posterior is twice as large as the anterior sucker, is quite circular, prominent, 1 millim. in diameter; it is placed just anteriorly to the middle of the ventral surface.

The pharynx is large, and cæca are developed from the hinder halves only of the two branches of the intestine.

The eggs are scattered abundantly through all but the anterior region of the body, and call to mind the figure given by Olfers of *Distomum folium*, from which species (found in the urinary bladder of *Esox lucius*) this may be at once distinguished by the absence of a neck; the eggs measure 0·1065 millim. in length, and ·07 millim. in breadth.

The length of the whole body is 5·5 millim., and its greatest breadth 3 millim.

The specimen of *Halosaurus* from which this fluke was taken was dredged off Cape St. Vincent at a depth of 1090 fathoms.

XV.—*On some Points in the Morphology and Classification of the* Saleniidæ, *Agassiz*. By Prof. P. Martin Duncan, M.B., F.R.S., F.L.S., and W. Percy Sladen, F.G.S., Sec. L.S.

Contents.

The Sur-anal or Dorso-central Plate and its Homologies; the Periproctal Plates. Some new Points about the Genera *Acrosalenia*, *Peltastes*, and *Salenia*, and a reconsideration of the Classificatory Value of the Genera *Pseudosalenia*, *Hyposalenia*, *Goniophorus*, and *Heterosalenia*.

I. *The Sur-anal Plate.*

When the genus *Salenia* is mentioned, or the family of the Saleniidæ, to which it belongs, one of the most important structures inevitably arises in the mind—the sur-anal plate, with its many synonyms. The term has been an unfortunate one, although nothing could have been clearer than the meaning which its author desired to give it. L. Agassiz wrote, in his Monogr. d'Échinod. Viv. et Foss., 1838, livr. i. p. 6:—"The genus *Salenia*, restricted within the limits now assigned, is characterized by an odd plate placed in the midst of the oviducal apparatus, which I shall call the sur-anal, which, consequent on its position *vis-à-vis* to the anal aperture, always renders the anus excentric."

L. Agassiz did not mean to imply that the plate was on the anus, although not having seen a recent *Salenia* he did not distinguish between the orifice of the anal tube—the anus proper—and the periproctal ring, which gives attachment to the membrane which has the anal passage in it. He meant *vis-à-vis* to the periproctal ring. The name of the plate in question has been subjected to several alterations, and its morphological meaning and homologies have been repeatedly discussed.

Alex. Agassiz* in 1864 pointed out that in young examples of *Strongylocentrotus* the central area of the apical or abactinal system is closed by a single large circular plate which occupies the whole of the space within the ring of the genital or basal plates. During the succeeding stages of growth this plate does not increase in size, but is more or less resorbed. Numerous supplementary plates are subsequently formed on the periproctal membrane, from which, at the adult stage, the original primary plate is often scarcely distinguishable.

The same naturalist, when studying, at a later date, a recent *Salenia*, showed that the sur-anal plate (called by him sub-anal) is the homologue of the first-formed central plate of young Echini, and remarked † that "the abactinal system of *Salenia* is entirely homologous with the abactinal system of the other Echinoids," the original central plate retaining a greater preponderance than is the case in other genera.

Lovén ‡ is very definite in his views regarding the homology of the sur-anal plate of *Salenia* and the primary central abactinal plate of young Echinidæ, and he terms both the "central disk" of the dorso-central system.

In his remarks upon the apical system of *Strongylocentrotus*, after referring to the discoveries of Alex. Agassiz, he observes that the "central disk" is developed before the anal opening of the intestinal canal is formed, and that the arrangement of the parts is such that the opening cannot occur, except after the putting aside or partial resorption of the disk. Consequently the central disk, far from being a simple protecting appendage of the anal opening, must be considered as a "pièce à elle" and independent—an integral part of the dorso-central system having a special morphological value. He then proceeds to state that "*Salenia* furnishes a conclusive proof of this, as Mr. Alex. Agassiz has remarked. In this genus the

* "On the Embryology of Echinoderms," Mem. Amer. Acad. 1864, vol. ix. p. 12.

† 'Revision of the Echini,' p. 259.

‡ 'Études sur les Échinoïdées,' p. 69 *et seq.*

central disk, far from having an ephemeral existence as in the Echinidæ, is permanent, occurring throughout the lifetime of an individual as a persistent and solid plate, growing with the other pieces of the skeleton, and filling the central space with its lamina, which is perfectly pentagonal. When the anal orifice opens out, it becomes partially eroded at the edge by resorption." He concludes:—"But the central disk always retains, in a perfectly recognizable manner, its primitive pentagonal form, and it is evident that it is not a sur-anal or supplementary plate occurring in *Salenia* and its allies, but is a normal part of the skeleton which persists throughout the life of the animal."

Herbert Carpenter, following A. Agassiz and Lovén, homologizes the sur-anal plate of *Salenia* with the primary central plate of the abactinal system of *Echinus*; and furthermore, in his instructive essay "On the Oral and Apical Systems of Echinoderms" (Quart. Journ. Micr. Sci. n. s. vol. xviii.), he establishes, on logical grounds, the true homology of a corresponding plate in the Crinoidea, Asteroidea, and Ophiuroidea.

Alex. Agassiz, with his characteristic generosity, sent to one of us a very fine and large specimen of *Salenia Pattersoni*, A. Ag., in spirit; and its study has enabled us thoroughly to appreciate our friend's admirable descriptions of the species in the "Report on the Echini of the 'Blake' Expedition," p. 13, pls. iv. and v.

In this specimen the sur-anal plate is large and as well defined as in any fossil *Salenia*; it is, as is usual in *Saleniæ*, incomplete in the right posterior angle, and this part is, as usual, eroded more or less by the periproct. The plate forms a part of the ring of the periproct. The periproct is large, and has a rather stout membrane, which is attached to the edge of the ring formed by the sur-anal and the basals 1 and 5; the anal orifice is central and the space between it and the ring is covered with well-formed plates, which are large near the ring and smaller and more numerous near the orifice, and most carry stunted spines. (See also A. Agassiz, 'Blake' Echini, pl. iv. fig. 18.)

These plates of the periproctal membrane, which become more numerous with age, are the homologues of the similarly placed plates of *Echinus*, *Strongylocentrotus*, &c., and they bear the same relation to the orifice of the anus within the periproctal ring.

Alex. Agassiz examined the young forms of *Salenia* dredged by the 'Blake' with the expectation that they might "throw some light on the formation of the sur-anal plate and its homo-

logy with the single large anal plate of the early stages of young Echini belonging to other families" ('Blake' Echini, p. 18). He states:—"But in all the young stages, even when not measuring more than 1·5 millim. in diameter, the arrangement of the plates of the abactinal system does not differ from that of the older specimens, the sur-anal plate being only proportionally somewhat smaller." He states that, in the youngest stage of *Salenia* examined, the anal system is distinctly pentagonal and covered by eight large triangular plates.

From the foregoing observations it may be deduced that the central plate of the abactinal system is a primary embryonic plate, which in *Salenia* and its allies grows *pari passu* with the growth of the test, and by this means remains contingent through life, along the greater portion of its circumference, with the basal plates. It thus lies outside the periproctal ring, of the margin of which it contributes to form a part, and the supplementary plates which are formed on the periproctal membrane are prevented from inserting themselves between it and the neighbouring basal plates.

In the Echinidæ, on the other hand, the primary central plate does not grow as the test grows, but may even be diminished by a greater or less amount of resorption. Consequently it always lies inside the periproctal ring, and the supplementary plates which are formed upon the periproctal membrane insert themselves between the rudiments of the primary central plate and the basal plates; and, finally, in the adult stage, the primary central plate may have become so insignificant as to be scarcely distinguishable from the supplementary or so-called "anal" plates. Although thus masked and diminished in size, the significance of the plate from a phylogenetic point of view is in no way lessened.

The persistence of a sur-anal plate ever since the age of the Lias (an age not greatly removed from that in which the Perischoechinidæ alone were represented) in *Acrosalenia*, *Peltastes*, and finally in *Salenia*, shows that the plate has a very great significance, and this has impressed every naturalist who has studied the structural resemblances of the great groups of the Echinodermata.

As a sequel to these remarks upon the sur-anal plate, it is extremely desirable to fix its proper terminology, for neither of the names given to it by the elder Agassiz, and by A. Agassiz, nor that suggested by Lovén is free from objection. Sur-anal, sub-anal, and central plate bring the structure too much into relation with the anus, with which it has really nothing to do.

The term sur-anal should imply a plate which is situated upon the anus, and in such a sense the primary central plate of young Echinidæ might in its primitive position, before the actual existence of an anal aperture, be styled, with some reservation, a sur-anal. But to its ultimate position the term is totally inapplicable. This fact is still more conspicuous in the case of the sur-anal plate of L. Agassiz in *Salenia*, which, lying in front of the periproct, outside the ring of which it forms a part, has nothing to do with the anal orifice.

As Lovén has called the apical or abactinal system the "dorso-central system," an appropriate term for the plate in question will be the "dorso-central plate," which also has the advantage of having been already employed by Herbert Carpenter and other writers.

The homology of the dorso-central plate has been the subject of careful study by A. Agassiz, Lovén, and Herbert Carpenter, and some differences of interpretation exist; but, in our opinion, the forcible arguments of the last-named naturalist carry conviction. The case has been so clearly and fully stated by him that we consider it unnecessary to recapitulate the evidence upon which his deductions are founded, and that it will be held sufficient for our present purpose to state that we agree with him in considering that the dorso-central plate of Echinoids, Asterids, and Ophiurids is homologous with the radical plate or root-disk at the extremity of the stem of the Pentacrinoid larva.

To the supplementary plates developed on the periproctal membrane and surrounding the aperture of the anus the name of "anal plates" has been given; but we think that "periproctal plates" would be a preferable term, as a means of avoiding any chance of confounding them homologically with the definitely-placed anal plates of the older Crinoids.

These supplementary or periproctal plates are well seen in the Cidaridæ, Saleniidæ, Diadematidæ, Echinidæ, and in fact more or less definitely in all the Echinoidea. They show a considerable amount of variability in their character and disposition. In some forms they are present in the younger stages as large solitary plates with more or less curved outlines, which become resorbed and added to in number, until a collection of various sized plates surrounds the anal orifice, the largest plates being nearest the ring of the periproct. In other forms the periproctal plates may persist as four, five, or more triangular pieces having their bases attached by ligament to the inner part of the periproctal ring, their free angle surrounding and assisting in closing, when

required, the anal orifice. In the irregular Echinoidea the plates above the anus are often the largest.

II. *On the Genera of* Saleniidæ.

Genus Acrosalenia, Agass.

The structures of the apical system of some of the species of this genus are more readily comparable with those of the other great groups of the Echinoidea than those of *Salenia*. Thus *Acrosalenia spinosa*, Agass., from the Inferior Oolite, presents a symmetrical pentagonal dorso-central plate, which is in the polar axis of the test and in the antero-posterior axis of the apical system; it is placed within the antero-lateral basals, to which it is fixed by suture. It is limited posteriorly by the periproct, which curves its posterior border. The plate is ornamented with small tubercles which carried spines, its construction resembles that of the basals, and it was immovable. The periproct is thrown backwards, and owing to the fixity of the dorso-central plate the posterior basal (5) became small and the radials I. and V. came within the periproctal ring. The anal (periproctal) plates are not preserved, but they doubtless surrounded the anal aperture within the periproct.

In *Acrosalenia decorata* (Haime, sp.), Wright, from the Corallian, the dorso-central plate is in its normal position, and occasionally it is perfectly hexagonal and in no way eroded for the periproct (Wright, Monogr. Brit. Foss. Echin. Oolitic Form., Pal. Soc. 1856, pl. xvii. fig. 1 *f*). Behind this plate are five or six others, and then comes what might be well considered to be the periproctal ring; but from the position of the radial plates it would appear that the smaller plates in contact with those behind the dorso-central plate may be within the periproct. Almost as good an instance of the preservation of a geometrical dorso-central plate without any notching for the periproct is seen in Bone's good figure on the same plate, fig. 1 *g*, and there are no supplementary plates, but a large periproct. Of the independence of the dorso-central in this species there can be no doubt.

Acrosalenia Loweana, Wright, has small additional plates which separate the dorso-central from the postero-lateral basals, but it would seem that they are really supplementary plates. In *Acrosalenia Wiltoni*, Wright, there is a row of plates between the dorso-central and the large periproct, and they are supplementary plates (Wright, *op. cit.* pl. xvii. fig. 5).

The entrance of the posterior radial plates into the peri-

proctal ring is usual in these species, and in some others, such as *Acrosalenia pustulata*, Forbes, in which the dorso-central is accompanied by supplementary plates, the anterior radial plate (III.) may enter the space between the antero-lateral basals. All this persistence of a dorso-central, and its occasional association with supplementary plates, and its growth in relation to the other parts of the apical system, was accompanied by movement outwards of basal plates and inward movement of radials.

One of the later *Acrosaleniœ* (*A. angularis*) varies in the nature of the plates accompanying the dorso-central, as may be noticed in the figure given by Lovén (' On *Pourtalesia*,' 1883, p. 66, and de Loriol, Mém. Soc. Pal. Suisse, vol. xii. 1er supp. à l'Échin. Helv. 1885, pl. i. fig. 4). This species is as interesting as the last of the *Acrosaleniœ* (*A. miranda*, Cott., Péron, & Gauth., Éch. Foss. de l'Algér., 2e part. p. 86). This Neocomian species has the dorso-central large, central, and separated from the periproct by some small periproctal plates.

It appears that in *Acrosalenia* some species have a perfect dorso-central with an angular posterior part; others have it eroded for the periproctal ring; others have small supplementary plates between it and the ring or elsewhere.

There is a very important character which is present in all the species of *Acrosalenia*; it refers to the so-called cuts or branchial grooves at the peristome. These grooves and indentations of the peristome are very well developed and are large for the size of the test; they pass up on the outside for a short distance along the line of the interradio-ambulacral sutures, and each one is bounded by a raised rim or edge. Although Desor stated to the contrary, these grooves are well seen in good specimens, and give a marked character to the genus. The corresponding parts are small in the genus *Salenia*, and it is now known that the branchiæ are small in the recent species. It will be observed that in this character *Acrosalenia* departs more from the type of the Cidaridæ than *Salenia*, and yet the first-named genus is the older one.

The Perignathic Girdle.—This structure may be seen after careful removal of the matrix when it is soft. The ridges are broad and low, and the processes are moderately tall and slender; they do not usually arch over the ambulacra, but they may join at their free ends and thus arch in some specimens. The type is not that of the Cidaridæ, but of the other Endocyclica (see Journ. Linn. Soc., Zool. vol. xix. p. 179).

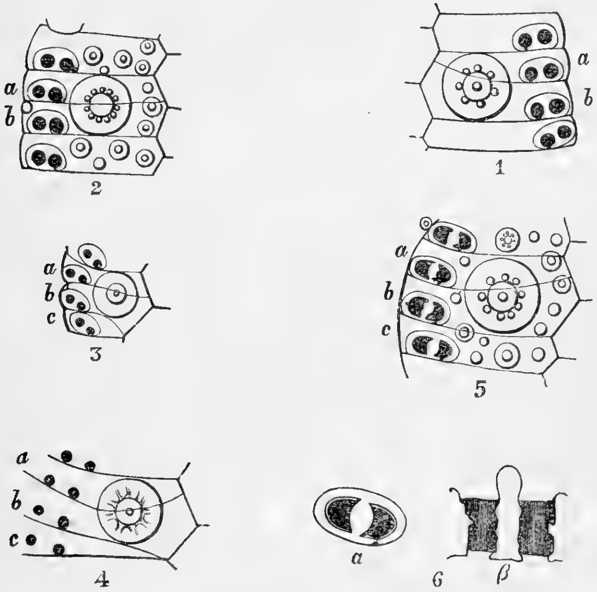
The Ambulacral Plates.—One of the reasons why the Saleniidæ have been considered to be closely allied to the Cidaridæ is that the ambulacral plates in both groups are

believed to be low primaries, each with a pair of pores; it has also been stated that in neither of the types is there any biserial arrangement of the pairs near to the peristome. But the crowding out of pairs and the biserial arrangement has been described in every species of *Acrosalenia*. The construction of the ambulacral plates has, however, not hitherto been described, and it is very interesting and important in classification.

Desor is only partly correct in his statement that the pairs of pores in *Acrosalenia* are "simple," meaning that there was a pair for each plate and that there were no compound plates. The ambulacral plates are simple for varying distances from the radial plates, and are long low primaries, each of course with a pair of pores, the peripodium being well developed and the nodule between the pores of a pair often being broad and high.

In *Acrosalenia spinosa* the straight vertical row of pairs is interfered with not far above the ambitus, and three or four pairs of pores begin to be in slight curves, and this condition increases with the dimensions of the ambulacral tubercles. It is easy to trace, in weathered specimens, that there are compound plates in that part of the ambulacrum, and extending thence to the peristome. The plates have been originally primaries, and have been compressed from above downwards and in the contrary direction by the succession of plates and the growth of the comparatively large ambulacral tubercles. The succession is a simple primary followed by a compound plate made up of two primaries formed into a geometrical plate, the upper one, *a*, being the smaller and having its adoral sutural line passing from the adoral pore obliquely upwards and towards the median ambulacral suture, and crossing the tubercle on its aboral shoulder (fig. 1). The other or adoral primary, *b*, is larger, especially at the median suture of the ambulacrum, the greater part of which is formed by it. The two primaries constitute a compound plate and are formed into a geometrical figure. Then comes a single primary without a large tubercle, and this plate is broad, low, and about one half of the height of the compound plate above it. A compound plate comes next, and it closely resembles the one above; but the suture may be more transverse, and it is followed in its turn by a simple primary (fig. 2). This succession is repeated several times until close to the peristome, where crowding and decided curving in arcs of the peripodia occur (fig. 3). But the crowding (fig. 3) is not after the type of the Triplechinidæ, for instead of there being compound plates with three components, only two primaries (*a* and *b*) occur in a compound

plate, and the adoral peripodium, *b*, is close to the interradium. The lowest peripodium of the apparent triplet, *c*, covers nearly the whole of its plate, which is crowded out from and does not reach the median ambulacral suture; it does not form part of a compound plate, and it is a demi-plate (single). The crowding of the plates at the very edge of the peristome is still greater and the sutures are obliterated in the specimens; but it is evident that there are demi-plates there. In a specimen in the British Museum (fig. 4) there is a triple com-



Ambulacral plates of *Acrosaleniæ*; much of the ornamentation is omitted.

pound plate between the ambitus and the position of the commencing crowding of the pairs, in which pressure has united the usual two primaries, *a* and *b*, and also an adorally placed primary, *c*. The cause relates to the growth of a tubercle, and the adoral primary (*c*) has been so pressed from above downwards that it barely reaches the median ambulacral suture and is almost a demi-plate. This is the first step to the more decided crowding and deformation which are seen nearer the peristome.

It has been stated by more than one author that when the apical disk of *Acrosalenia hemicidaroides* is absent the specimens cannot be distinguished from those of a *Hemicidaris* deprived of that system.

But there are several important structural distinctions between the species of the two genera. For instance, the branchial cuts of the *Acrosalenia* are large and those of *Hemicidaris* are small; the great tubercles of *Hemicidaris* cover three plates arranged in a compound geometrical plate, and this is never the case in the *Acrosalenia*, which has the tubercle followed by a large granule in vertical succession, the tubercle being in relation with two plates of a compound one and the granule being upon a small, low, separate primary. The construction of the ambulacral plates differs completely in the two genera, and if the special arrangement of the great compound plates of a *Hemicidaris* described in Quart. Journ. Geol. Soc. vol. xli. p. 438, figs. 13, 14, 15, 16, is compared with similarly placed ones of *A. hemicidaroides* (fig. 5), the distinction becomes obvious; there are three component plates in the one and but two in the other species. There are no instances of compound plates made up of four plates in *A. hemicidaroides* as in *Hemicidaris*, and the slope of the plates and the directions of the sutures differ in the two forms. Near the peristome of *A. hemicidaroides* the crowding produces triplets, and they are remarkable, for, unlike the arrangement in *A. spinosa*, the adoral primary is long and low, the median primary is large at the median line, and the aboral primary is almost a demi-plate. The adoral suture of the last-named plate is much curved. There is a certain amount of resemblance in the peripodia of the two sets of forms, but those of the *Acrosalenia* (figs. 6 *a* and *β*) are characterized by a very prominent inter-porous knob which stands up well beyond the level of the test.

Acrosalenia pustulata, Forbes, was carefully studied by Wright (*op. cit.* p. 242, pl. xvi. figs. 2 *a*–*g*), who remarks upon its variability in specimens of the same dimensions, and of course in those of different ages. But Wright's specimens do not appear to have enabled him to give a figure of the apical disk which could be correct, and his descriptions of the structure are, naturally, not positive. His studies regarding the variability of the tests were directed to explain Forbes's seeming inaccuracy about the separate condition of the scrobicules of the large interradial tubercles and about the median area only having two rows of tubercles. Wright showed that Forbes's specimen was immature. In consequence of this perfectly correct view, Wright gave a new diagnosis of

the species (*op. cit.* p. 242). This description, made thirty-one years ago, readily enabled the species to be distinguished from all *Acrosaleniæ* except *A. Wiltoni*, Wright, and *A. Lamarcki*, Desor. If the figure given by Desor ('Synopsis,' pl. x. fig. 2) of *A. Lamarcki* be compared with specimens of *A. Wiltoni*, Wright, the distinction is evident. The shape differs and the scrobicules of the great tubercles are separated by two lines of granules; the width of the median ambulacral zone is less than that of *A. Wiltoni* and *A. pustulata*. The small peristome and small apical system distinguish the foreign species from *A. pustulata*. The distinction between *A. pustulata* and *A. Wiltoni* is, however, not great, and if the figures given by Wright (*op. cit.* pl. xvi. figs. 2 *a–f* and 3 *a–e*) be examined critically, the whole of the specific differentiations rest upon the dimensions of the peristome. We cannot agree to the correctness of Wright's fig. 2 *d*, pl. xvi., on which much depends. The whole of the pairs of pores on the line towards the interradium drawn are wrongly placed, and the adoral pores are made aboral; the arrangement of the tubercles and the granules between them and in the interporiferous area is not consistent with fact. There are really crowded granules between the tubercles, and at least three vertical sets of granules in the median area.

The width of the ambulacra is, however, well shown in the figure, and it is equal to that of a coronal plate bearing a large interradial tubercle, that is, the breadth of one half of an interradium.

Thus the statement made by Wright that the ambulacra of *A. pustulata* are narrow is contradicted. The truth is that they are wide for the size of the test and not quite so wide as they are drawn.

Again, in fig. 2 *d*, all the plates in the ambulacra are compound ones; and this is not correct, for the arrangement is exactly like that of the species already noticed in this communication.

The relative size of the apical disk and the position of the radials, and the number of accessory plates and the nature of the dorso-central, depend largely on growth, the adults and the half-grown differing considerably in these matters.

The youngest specimen we have examined, which is sufficiently well preserved to afford good results on examination, is 18 millim. high and 9 broad. The apical disk is on the whole tumid and raised above the test. The anterior basals are larger than the postero-lateral; basal 5 is well developed, is about one third of the size of a postero-lateral, is angular without and curved within, and has a single row of minute

tubercles parallel to the curved edge. The radial plates are broad adorally and the optic pore is in the adoral edge; the posterior radials enter the ring of the periproct and are elongate. The radials II., III., and IV. do not enter the periproctal ring. A well-defined, small, pentagonal, dorso-central plate is placed in the antero-posterior line of the test and bounds the periproct in front; its sides are not in contact with basals 1 and 4. A small supplementary plate is on each side of the dorso-central, and these side-plates are not symmetrical; they and the dorso-central plate bound the periproct anteriorly.

In examining a large series of specimens of the different species of *Acrosalenia* it becomes evident that perforate and imperforate tubercles may occur, although the perforate condition is by far the commonest. The entrance of a radial plate between the basals, besides the usual radials I. and V. is seen in some specimens of the species even in which the majority of forms have not this character. It follows that the position of the radials, all other characters being the same, is not sufficient to alter the specific character, much less the generic. The position of the radials and the perforate or contrary condition of the tubercles will be noticed as of no great importance in some types which are about to be described.

Genus Acrosalenia, Agassiz, 1840, amended.

Test moderate in size, depressed, tumid at the circular and rarely pentagonal ambitus, rounded above, flatter actinally. Apical system rather large; four lateral basals large, and the posterior smallest and differing in shape. A dorso-central plate in the antero-posterior axis of the system, in contact with the four larger basals and anterior to the periproct. Supplementary plates to the dorso-central may occur. Posterior radials enter the ring of the periproct, rarely a radial separating the antero-lateral and postero-lateral basals more or less. Periproct large and posterior. Ambulacra moderate or narrow, with primary plates near the apical system and with compound plates near the ambitus and actinally. Compound plates of two united primaries with rare demi-plates, except near the peristome. Pairs crowded and biserial near the peristome, from the presence of demi-plates. Tubercles of the interradia largest, perforate and crenulate; those of the ambulacra much smaller or only like large granules. Peristome large, decagonal, with well-developed branchial grooves with raised edges. Perignathic girdle with low ridges and slender pro-

cesses sometimes uniting. Spines large and small, the former striated longitudinally, or plain, and often not quite circular in transverse section; smaller spines striated.

Distribution. Fossil: Lias to Neocomian, England, Europe, and North Africa.

It will have been observed that *Acrosalenia* is the oldest of the Saleniidæ and that its species are more complex than those of any other genus of the family. The frequent perfection of the dorso-central plate, the existence of compound plates in the ambulacra, the well-developed branchial cuts, and the ridges and processes of the perignathic girdle separate the genus from the Cidaridæ, and it is more distinct from that family than are the genera *Peltastes* and *Salenia*.

These last-named genera can hardly have had an Acrosalenian ancestry. *Acrosalenia* became extinct before *Salenia* attained much importance, but there was a *Peltastes* with Acrosalenian affinities in the time of the Oolite.

Genus Peltastes, Agass.

The oldest species of the *Peltastes*-group is a true *Peltastes* in all the characters but one, and that is remarkable, for the primary tubercles of the interradia are perforate as well as crenulated.

There are several specimens of this species from the Corallian of Wurtemberg, and the locality Nattheim, in the British Museum, and they correspond with *Acrosalenia interpunctata*, Quenst. (Petref. p. 576 (old edition), pl. xlix. figs. 5 and 6). The test is depressed and the apical system is large; the basals are large, the posterior unusually so, and the dorso-central is comparatively small. The periproct is directly posterior. The ambulacra are narrow, wavy, and have two rows of small secondary tubercles, so closely placed that nothing is seen between them along the median suture. The pores are moderately numerous, in simple series, and there is a pair to each plate, and there are no primary plates joined to form compound plates, but every plate is separate, as in *Peltastes* and *Salenia*. Neither the apical nor the ambulacral development is that of *Acrosalenia*.

The primary tubercles of the interradia are large and have perforate mamelons and crenulated bases. The branchial cuts are small. Quenstedt noticed its many-sided character, and it is now necessary to place the form as follows:—

Peltastes interpunctatus, Quenst., sp.

Jurassic.

Edward Forbes considered the genus *Peltastes*, Agass., to be of doubtful value, and believed that it was a section or subgenus of *Salenia*. There is much to be said in favour of this view; but it must be admitted that there is equal reason for regarding *Salenia* as a subgenus of *Peltastes*. But the species of *Peltastes* as a whole are older geologically than those of *Salenia*, and the generic distinction is the presence of a dorso-central plate in the antero-posterior axis of the apical system and of a periproct which is placed posteriorly to the dorso-central plate in *Peltastes*, and not to the right posterior, as occurs in *Salenia*. In all other important structures there is no morphological distinction to be made, although there are distinctions to be drawn regarding the ornamentation. The only satisfactory argument which can be advanced against the combination of the two types is that the species of each are numerous and definite, and that the *Peltastes* are extinct. The two groups are not connected by any intermediate species. We retain the genus *Peltastes* after indicating the very close affinity with *Salenia* and the probability of the last-named being a descendant of the first.

Genus PELTASTES, Agassiz, 1838, Monogr. des Salénies; amended in Catal. raison. Ann. des Sci. Nat. 1846 (non Desor, Synopsis, p. 145).

Test small, circular in outline, tumid at the ambitus, depressed and slightly tumid abactinally, or tall, with a part of the apical system projecting, actinally rather flatly curved. Apical system large, raised slightly, and part of it usually projecting, with large basals and small radials; a dorso-central plate small, in the long axis of the system, united to the basals 1 to 4, but not touching the basal 5, curved posteriorly for the anterior margin of the periproct. Radials large, not within the ring. Periproct posterior, bounded in front by the dorso-central plate and posteriorly and laterally by the basals 4, 5, and 1. The sutures of the disk often grooved, marked with depressions and the prolongation of the ornamentation of the basal and dorso-central plates; these plates with grooves and eminences often radiate in arrangement, margins of the basals often variously curved and notched. Ambulacra narrow, straight or slightly flexuous, with small primaries near the poriferous zone; plates low primaries only. Interradia with large primary tubercles at the ambitus, diminishing in size above and below, crenulate and usually imperforate. Peristome small, rather reentering, slightly incised.

Perignathic girdle with low broad ridges and slender unarched processes.

Distribution. Fossil: Upper Jurassic, Europe; Cretaceous, Europe and England.

There are two genera, one established by Cotteau, and the other by Desor, which can hardly be separated from *Peltastes*, namely *Pseudosalenia*, Cotteau, and *Hyposalenia*, Desor.

Pseudosalenia, Cotteau, 1859, Éch. nouv. ou peu connus, p. 22. It has the apical system projecting, non-granulate, marked with sutural impressions, with very narrow, often flexuous ambulacra, the tubercles of which are imperforate, except near the actinal surface. The dorso-central plate is in the axis of the test, and the periproct is posterior as in *Peltastes*. The figures given by Cotteau in "Note sur la famille des Salénidées," Bull. Soc. Géol. de France, 2e sér. t. xviii. p. 622, show that the dorso-central plate is as perfect as in *Acrosalenia spinosa*, and there do not appear to have been any accessory plates. No radial enters the periproctal ring. The nature of the ambulacral plates is not known, but the perforate or imperforate condition of the tubercles is not of generic value. There really is no satisfactory distinction between this genus and the well-defined *Peltastes*, and we consider the genera to be synonymous.

Hyposalenia, Desor, 1858, Synopsis, p. 147, pl. xx. (non xix.), is synonymous with *Peltastes*, with which it was originally associated. Wright unfortunately admitted the genus and misquoted Desor. He stated, in his table of the genera of the Saleniidæ, *op. cit.* p. 228, that the vent is "excentral, posterior, and inclined to the right side." This is a mistake, and it is satisfactory to know that it was withdrawn subsequently.

The genus *Goniophorus*, Agass., 1838, Monogr. des Salénies; Desor, Synopsis, p. 146; Cotteau, Bull. Soc. Géol. de France, 2e sér. t. xviii. p. 624 (1861), is so closely allied to *Peltastes* that there has been some discussion whether it should not be considered a subgenus of it. Cotteau, however, drew attention to deep circular depressions at the base of the ambulacral granules near the ambitus, and he noticed pores in them resembling those of the poriferous zones. He considered that these depressions were unique amongst the Echinoidea, and therefore the type remained as a genus. All the other characters of the species included under *Goniophorus* are subgeneric. There are some excellent specimens of the common species in the Museum of Practical Geology in Jermyn Street, and they

show the depressions first noticed by Cotteau. The ambulacra are very narrow, and the tubercles are small and crowded actinally; the pores are rather large, and the pairs are environed by a peripodium with a narrow linear and raised edge; the ambulacral plates are low primaries, and there are no compound plates. The depressions are deep and more or less circular in outline, and they are evidently in the line of suture between contiguous ambulacral plates; and, as the tubercles (not granules) are crowded and sometimes nearly cover the sutures, the position of the depressions is at the base of a tubercle, or where a tubercle might have been. Really the depressions are pits in the line of suture and somewhat resemble the deep groovings of the Temnopleuridæ; but there are no deep and large pits at the angles of the plates as in that family.

The pits are confined to the surface below the ambitus and get crowded near the peristome. The specimens examined by us do not show any pores on the floor of the pits, but, on the contrary, where any structure is to be seen it is of a nature indicating the appearance of the former presence of articular tubercles of sphæridia. We consider that as the principal characters of *Peltastes* are present in the species, they must come under a subgeneric group.

Subgenus *Goniophorus*, Agassiz (genus), 1838.

Test small, swollen, subspheroidal, with large peristome, few interradial primaries, plain and crenulated. Apical system pentagonal, with five basals and five small radials ornamented with linear and raised straight keels not on the lines of the sutures; a dorso-central plate; periproct posterior to it and elongate transversely. Pits for sphæridia large in the narrow ambulacra actinally.

Distribution. Fossil: England, Europe; Upper Greensand.

The genus *Peltastes* therefore has as its synonyms *Pseudosalenia* and *Hyposalenia*, and there is a subgenus *Goniophorus*.

Genus Salenia.

The genus *Salenia*, Gray, Proc. Zool. Soc. Lond. 1835, p. 58, has been modified, added to, and divided by several authors, such as Desor, Cotteau, L. Agassiz, Wright, A. Agassiz, and Lovén, and contributions to the anatomy of the species of great importance have come from the last two naturalists. The recent forms have been, to a certain extent,

examined morphologically by those authors, as well as by L. Döderlein * and one of us †. A *résumé* of the different opinions regarding structure and classification is to be found in the Report on the 'Challenger' Echini, A. Agassiz, 1881, p. 50 *et seq.*, and its perusal leads at once to the belief in the necessity for an amended diagnosis of the genus.

A. Agassiz has placed the various matters under dispute so plainly and fairly, that an amended diagnosis should come from him; moreover, the knowledge now possessed of the recent forms is mainly due to him. The recent species of *Salenia* form a little group in which, with one exception (*S. Pattersoni*, A. Agassiz), there are fewer ambulacral plates than in the Cretaceous forms, and even fewer than in the Tertiary species. The radial plate no. I. is often in contact with the periproct in the recent forms, although there is some variability of this position in the same species. This entry has been noticed in Mesozoic species also, but it is not of any classificatory importance. The abruptness of the transition from the typical form of *Salenia* to the recent forms is diminished by the presence of *Salenia Blanfordi*, Dunc. and Sladen (Pal. Ind. ser. xiv. Foss. Ech. of Sind, 1881, p. 29, pl. vi. fig. 4 (Eocene)), in which the recent characters are distinctly observed, although the ambulacral plates are more numerous than in the recent *Salenia hastigerina*, A. Agass., and *S. profundi*, Dunc., for instance. *Salenia tertiaria*, Tate, is from the Miocene of Australia and belongs to the modern type. Lately, and mainly owing to the kindness of A. Agassiz in providing one of us with a specimen of the recent *Salenia Pattersoni*, A. Ag., some important additions have been made to the morphology of the genus; moreover, the examination of a very well-preserved specimen of *Salenia petalifera* from the Upper Greensand has presented some interesting structures to view for the first time. The new facts regarding the structures of these species necessitate some alteration in the generic diagnosis. The perignathic girdle of the modern form is the same as that of the ancient species, and whilst both resemble those of *Acrosalenia* and *Peltastes* they are very different from the structure seen in the Cidaridæ. In both of the above-named species there is distinct doubling of the pairs of pores, each pair in a peripodium, close to the peristome, and it is evident that demi-plates occur there. This appearance is most marked in *S. Pattersoni* and in no other recent form, but

* Döderlein, Archiv für Naturgesch. Jahrg. 51 (1885), Bd. i. pp. 73–112.

† P. Martin Duncan, Ann. & Mag. Nat. Hist. ser. 4, vol. xx. pl. ii. p. 70, pl. vii. p. 245.

it is equally visible in *Salenia petalifera*. The other fossil species do not appear to present the crowding necessary to produce the deformation. The sphæridia discovered by one of us some years since, and the recognition of the external branchiæ in the same form, *Salenia profundi*, Dunc., 1877 (Ann. & Mag. Nat. Hist. ser. 4, vol. xx. p. 245), were strong points against associating *Salenia* with the Cidaridæ, and now the presence of a perignathic girdle with ridges and processes decides the necessity for the separation, which has received the sanction of A. Agassiz.

It is well known that the dorso-central plate of the *Saleniæ* has an angle pointing to the suture between the basals 2 and 3, and that the periproctal ring is not posterior, but is formed at the expense of the right posterior corner of the dorso-central and of the inner edges of the basals 1 and 5. The dorso-central is in contact with basals 2, 3, 4, and in slight contact with basals 1 and 5. This is seen in *S. scutigera* and in the Eocene *S. Blanfordi*, also in *S. varispina*, in which the basals 5 and 1 are just touched, and this is also the case in *S. Pattersoni*, A. Agass. *S. hastigera* has the same arrangement.

The question of the orientation of a *Salenia*, *Peltastes*, or *Acrosalenia* need not quite depend upon the appreciation of the position of the madreporite. In a species which has given A. Agassiz and one of us some trouble, or rather a specimen of a species which Agassiz has since perfectly defined, viz. *S. varispina*, there were two basals perforated by the madreporic body. The result of placing the madreporite seen by one observer as a body in the right anterior basal (no. 2) was to throw the anus posterior to the dorso-central plate, and to suggest that the form was more Peltastic than Salenian. But A. Agassiz, selecting the other basal (no. 1), which was also perforated, came to the inevitable conclusion that the species had the anus excentric behind and to the right hand, that is to say it was a *Salenia* *. It is not uncommon to find the genital duct opening so large and ragged in more than one basal in fossil forms that the simulation of the ragged opening of the madreporite is perfect. Under the circumstances the opportunities of making mistakes are at hand, and it may be impossible to settle which basal is no. 2, so as to place radial III. in front, and proceed to determine the antero-posterior axis of the apical system.

Often no trace of a madreporite can be seen. Under such difficulties the method of Lovén of distinguishing the oblique

* Revision, pl. iii. figs. 9 & 11; also Report on 'Blake' Echini.

actinal axis may be used, after discovering by his method which is interradium 3 actinally (Lovén, ' Études,' p. 47).

The periproctal ring of *Salenia* is formed by the basals and the dorso-central plate in the majority of species and in many specimens of some species; but a radial plate may come in, and it is the radial I. which thus occasionally enters. Usually there is an elevated ridge at the edge of the ring, which is caused by an upward growth of that part of the plates. There may be granules or stunted sessile spines, or even small spines on the ring, or it may be plain. The inner edge of the ring gives attachment to the periproctal membrane, and this is penetrated more or less centrally by the anal tube. A series of plates, few in number in the young and more numerous in older specimens, covers the membrane, and usually the plates are in irregular circles around the anus, or the plates may radiate from the ring to the anus and become smaller and more numerous with age. The plates may carry spinules or small knobs.

The number of the primary ambulacral tubercles varies with the species, and so does the closeness of the two vertical rows in which they are arranged; the granulation between the rows differs also in extent and amount. The number of primary plates of the ambulacra is greater in the Mesozoic species than in the Tertiary and recent, except in *S. Pattersoni*, A. Ag., in which the primaries are so crowded that there is doubling of the pairs of pores near the peristome. It is the case that the later *Saleniæ* can be classified in a little group by themselves in the genus.

There is great diversity in the ornamentation of the basals, radials, and dorso-central plate in the species of *Salenia*, and while it is of a radiating and grooved character in some species it is almost plain in others; there may be almost a perfect resemblance to the ornamentation of *Marsupites*, or there may be but a slight radiation of furrows and ridges amongst the other ornamentation, or only spinules may exist fixed without knobs. The sutures of the plates may be just visible, but usually they are distinct and often pitted, and the ornamentation has some reference to the spaces between the shallow pits. Pedicellariæ occur on the apical system and elsewhere.

Genus Salenia, Gray, 1835, amended.

Test small, subglobose or depressed. Apical system larger than the peristome, more or less raised. The dorso-central plate more or less geometrical, imperfect, and eroded at the right posterior angle by the periproctal ring, in contact with all the

basals. Radial plates large, with the pore in the adoral edge; one plate may or may not enter the periproctal ring. Periproct large, with a plated membrane pierced by the anal opening. Ambulacra narrow, with two rows of primary tubercles; plates all simple primaries; crowding rare near the peristome; when it occurs there are demi-plates. Interradia with large primaries. Peristome with cuts for the external branchiæ, with a membrane plated or not. Perignathic girdle with broad ridges and slender ununited processes; jaws with the opening of the pyramid unarched; teeth with a keel. Spines of primaries long, slender, variable in ornamentation; small spines club-, wedge-shaped, and flat. Sphæridia exist.

Fossil: Cretaceous, England, Europe, Asia, North Africa; Eocene, Europe, Asia; Miocene, Australia.

Recent: Caribbean Sea, both of the great oceans, Japanese Sea. Depth from 60 to 1700 fathoms.

It will have been remarked that nothing is said in this diagnosis about ornamentation of the apical plates, or about the crenulation and condition, whether smooth or not, of the mamelons of the primary tubercles. The ornamentation is that of the family, and the perforation or non-perforation of the tubercles, of all which are crenulated, is not of generic importance when the subgenus *Heterosalenia* is considered. The imperforate condition is typical of the true species of *Salenia*; and the only distinction between Cotteau's *Heterosalenia* and these is a perforate condition of the primaries in the last-named genus, or rather doubtful subgenus, which has but one species in the Hippurite Chalk of Martigues.

The forms which have been considered in this communication evidently belong to a family which is separable from the Cidaridæ on the one hand, and the Diadematidæ, Arbaciidæ, Triplechinidæ, and all other regular Echinoidea on the other.

Family **Saleniidæ.**

Regular endocyclic gnathostomes, with a persistent dorso-central plate. A periproct posterior, directly or partly to the right of the dorso-central plate, with a plated membrane, which gives passage to an anal aperture. Ambulacral plates either primaries or compound primaries. Perignathic girdle with ridges and processes. Branchiæ external.

Genus ACROSALENIA, Agass., 1840, amended.

Syn. *Pseudosalenia*, Cott.

Genus PELTASTES, Agass., 1838, amended.

Syn. *Hyposalenia*, Desor.

Subgenus GONIOPHORUS, Agass., 1838.

Genus SALENIA, Gray, 1835, amended.

Subgenus HETEROSALENIA, Cott., 1861.

XVI.—*On the Pelagic Fauna of our Shores in its Relation to the Nourishment of the Young Food-Fishes.* By Prof. M'INTOSH, M.D., LL.D., F.R.S., &c.*

BY the term pelagic fauna is meant the inhabitants of the whole body of the water from the surface to the bottom. This immense area, it is well known, varies greatly in depth, viz. from 4655 fathoms (that is upwards of five miles), as sounded by the American exploring-ship 'Tuscarora,' near the Kurile Islands in the North-east Pacific, to a few inches, as on gently sloping sandy beaches.

The pelagic fauna of the surface of the ocean has for ages attracted the attention both of voyagers and of scientific men. In the tropical and subtropical regions especially the abundance and variety of such animals are remarkable; yet they are not confined to these warmer areas, certain types, as copepods and pteropods, occurring in such countless multitudes in the arctic seas that they form the food of the right whales. The colder waters, just mentioned, however, do not, as a rule, present the brightly coloured and conspicuous swimmers of the warmer areas, such as Portuguese Men-of-war, Venus's Girdles, the exquisite siphonophores, pelagic annelids (e. g. *Alciopa*), and certain types of pteropods and crustaceans.

In our own seas, even the most superficial observer on the eastern coast must have been struck by the great beauty and abundance of the lilac *Aureliæ*, the deep purple of the young or the rich brown of the adult *Cyaneæ*, frequently stranded in multitudes on sandy beaches in autumn; while in the milder waters off the western shores the greater variety of the purple and reddish medusæ (e. g. *Pelagia*, *Æquorea*, *Modeeria*, *Oceania*), the occasional occurrence of such truly oceanic forms as *Physalia*, *Velella*, and *Ianthina*, the long chains of Salpæ, and the crystalline calices and orange polypites of

* Abstract of Introductory Lecture to the Class of Natural History, University of St. Andrews, November 13, 1886.

Diphyes, besides other rare forms, make up a characteristic pelagic fauna.

In connexion with the consideration of the vast number of free oceanic animals near our own shores, a feature, perhaps not sufficiently appreciated, is the fact that a constant interchange takes place between the upper regions and the bottom, and this at very considerable depths *. So far, indeed, as present observations go, there is no reason why any region of the water, say between 200 fathoms or more and the surface, should be azoic †. Thus many of the deep-sea starfishes have larvæ which swim near the surface of the water, and they again descend when they have reached a stage in which the main features of the adults have been reproduced. Many of the Pleuronectidæ, such as the plaice, turbot, and craig-fluke, which habitually live on the bottom, produce eggs which are truly pelagic and float near the surface of the water, as also do the early embryos. The young, however, as they grow older sink deeper and deeper in the water, until at a certain stage they take up their residence at the bottom, like their parents. Such animals, therefore, at different periods of their existence inhabit separate zones of the water, and thus form one of the great groups into which pelagic animals may be divided, viz. those *Temporarily Pelagic*, the other division being constituted by those *Permanently Pelagic*.

The area from which this temporary pelagic life is derived is extensive, for every patch of sponge covering rocks, stones, and seaweeds, many hydroid zoophytes and other cœlenterates, many echinoderms, the majority of the annelids, many Polyzoa and tunicates, and numerous shell-fishes, send off periodically a succession of ciliated free-swimming larvæ. Moreover, such occurs not only between tide-marks but wherever marine animals exist on the sea-bottom.

In briefly alluding to the various forms which people the region under consideration, on the east coast, it is found that besides the pelagic fauna there is a pelagic flora, the most abundant forms being diatoms and desmids, the former occurring everywhere near the surface of the water, in the stomachs of pelagic animals in mid-water, and in the alimentary cavities of ascidians fixed to the bottom. The pelagic Foraminifera and radiolarians again are equally abundant at the surface and at the bottom, and the living as well as the dead may pass from the upper to the lower region of the water. The upper parts of the sea teem with Infusoria, such as *Ceratium*,

* *Vide* Report of H.M. Trawling Commissioners, 1884–5, p. 372 &c.

† Prof. Moseley is unable to give a decided opinion on this point, or thinks that a vast region may be azoic.

Peridinium, and *Tintinnus*, and they are also present in the stomachs of annelids and other forms more or less fixed to the bottom. The free-swimming larvæ of the sponges, as formerly indicated, also materially augment the pelagic fauna.

Amongst cœlenterates the various true Medusæ with their larval forms are often in immense abundance, and so are the Hydromedusæ and their ciliated planulæ. The most common types of the Hydromedusæ are *Thaumantias*, *Bougainvillia*, *Turris*, *Oceania*, and the little zooids of *Obelia*, a zoophyte which forms a dense coating on the ropes of stake-nets for salmon and other submerged structures with considerable rapidity. In the same way the Zetlandic waters are occasionally rendered phosphorescent by multitudes of similar free buds. The ctenophores (*Pleurobrachia* and *Beroë*) are also often very abundant. In connexion with the occurrence of the foregoing cœlenterates, it is well to point out that they do not always come to the surface, indeed they may be in vast multitudes though not a single example is seen. As a rule, Medusæ of various kinds appear to pass their younger stages in the lower regions of the water, and only come upwards in certain seasons and under certain conditions. Their presence is often first discovered by the trawl, and subsequently they are noticed on a calm summer evening at the surface, which is broken here and there by their contractions. The reasons for this irregularity in the appearance of the Medusæ are not at present clearly understood, and they are not altogether due to atmospheric or oceanic causes.

The echinoderms, from holothurians to rosy feather-stars, add largely to the temporarily pelagic fauna, since the larvæ in most of the genera mount near the surface and only return to the bottom after the adult shape is assumed. The influence which even such forms as the Ophiuridæ, which generally live so buried in sand as to escape the trawl, have on the pelagic fauna is considerable, since their larval *Plutei* swarm near the surface.

The larval annelids, again, are almost universally pelagic, and off both sandy and rocky shores as well as everywhere on the bottom a vast number are annually set free. Some adults, again, as *Ioida* and *Tomopteris*, are only found in a pelagic condition, and others assume it in special phases connected with reproduction. *Sagitta* follows the same habit, and is occasionally observed in enormous numbers, their bodies sparkling like endless lines of glassy needles as they are stranded by the tide on the beach. The larval annelids affect the whole body of the water, and the same may be said of *Sagitta*.

The class Crustacea, as a rule, exceeds most of the other groups in the abundance and variety of its pelagic adults and pelagic larvæ. The tow-net, indeed, off the eastern shores in July and August is sometimes coated with a semisolid mass of their bodies, consisting of young cirripedes, copepods, larvæ of the common shore and edible crabs, porcelain crabs, and others, such as the common and Norway lobsters. These larvæ, as they descend to the bottom in their more advanced stages, may be reckoned as the fauna of all intermediate regions. Moreover, pelagic life is not confined to the larvæ, for the eastern bays occasionally swarm with such schizopods as *Thysanoëssa tenera*, G. O. Sars, and *Nyctiphanes norvegica*, M. Sars—Norwegian types discovered by the authors mentioned, the former being already known as British, while the latter, Dr. Merle Norman kindly informs me, for the first time appears on our list. Both forms occurred off the east coast, and especially in St. Andrews Bay, towards the end of April, and so densely that the tidal wave was crowded with them, and miles of sand were strewed with their bodies which the receding wavelets left in streaks and curves*. Various sessile-eyed crustaceans also occasionally occur at the surface, such as *Amphithoë*, *Lestrigonus*, *Lysianassa*, besides many Ostracoda and the young of *Diastylis*. Moreover the young of *Caligus* are sometimes in great abundance off rocky margins, and thus are ready to settle on the various food-fishes, none being more liable to attack than the cod.

Amongst the Molluscoida the ciliated larvæ of the Polyzoa and the tailed larvæ of many tunicates increase the pelagic fauna, especially in rich inshore regions; while *Appendicularia* is frequent in the tow-net both there and in the open sea. The eastern coast, however, presents a great contrast to the western in the entire absence of Salpæ, the chains of which sometimes occur in countless multitudes in the warm Gulf-stream bathing the Outer Hebrides.

The larval Mollusca are generally pelagic, and this is especially the case with the bivalves which inhabit sandy flats. Few, moreover, have any conception of the enormous numbers of the larval mussels alone which are poured into the various bays and the water beyond every year; though an idea of their abundance may be obtained by inspecting the solid mass which they form in the tow-net, or the rocks and zoophytes (*Obelia*, *Gemellaria*, &c.) at a somewhat later stage when assuming a sedentary existence. The pteropods (*Spirialis*) of the eastern waters, again, are pelagic throughout

* When dried they closely resembled chaff, for which, indeed, the uninitiated took them.

life, and they sometimes shun the upper waters for lengthened periods, being found only in the lower stratum, both by night and by day. As a rule, however, voyagers have captured them most abundantly in the tow-nets in the evening. D'Orbigny's pleasant but fanciful description of the habits of these forms is inadequate to explain such phenomena. Lastly, the larvæ of the cuttlefishes, which on the eastern coast deposit their eggs on the bottom, shoot upward into the water on emergence, and are as lively as the adults in ordinary circumstances are sluggish.

From the foregoing brief and somewhat imperfect summary it will be apparent that the animals which constitute the invertebrate pelagic fauna are both numerous and varied; and as the representatives of almost every group are more or less adapted to form the food of other types or even of its own, it follows that there is abundance of nourishment of this kind in the inshore and neighbouring waters, as well as in many parts of the open sea.

Further, the young food-fishes themselves form important members of the pelagic fauna. Almost every food-fish, indeed, passes through the pelagic phase, either temporarily as a pelagic form or remaining so throughout life, like the herring, the pilchard, and the mackerel. It is true the ova of the herring are deposited on and glued to the bottom; but the larval fish rises, as soon as it gains sufficient strength, to the upper regions of the water. Again, with the exception just mentioned and a few others, the majority of the Teleostean food-fishes produce ova which mount in still water to the surface or near it in more restless seas. The young are there hatched in a very incomplete state, generally without a mouth, and subsist for some days on the store of nourishment in the small yolk-sac *. They are carried about in a helpless condition by the surface-currents, but probably do not proceed very far from the area in which they emerged. Before the absorption of the yolk-sac the mouth has formed and the little fish, already full of activity, is in a condition to prey on the more minute forms around it.

Introduced into life from pelagic eggs and in the midst of pelagic surroundings, the young of the food-fishes much resemble each other in general outline, though there are certain characters, chiefly specks of pigment, which enable the zoologist to discriminate them. Each has a marginal fin commencing behind the nape of the neck and running vertically to the tail, which it includes, and then forward along

* *Vide* E. E. Prince, "Development of Food-Fishes," Ann. & Mag. Nat. Hist., May and August 1886.

the lower margin to the yolk-sac. The pectorals are nearly alike, and the ventrals are generally absent. Thus the young cod, haddock, whiting, ling, rockling, gurnard, flounder, dab, turbot, plaice, and others have a tolerably close resemblance. They are all nourished in this tadpole-stage by the small yolk-sac, and thereafter find the same minute food in the sea around them. Yet the five former chiefly seek in adult life the bottom waters; the sixth is a mid-water or bottom fish; while the four last-named are characteristically so, often lying buried in the sand.

During growth various modifications take place in the young fishes, some of them being probably adapted for their temporary sojourn in the upper regions of the water, while others may be due to heredity. As development of the muscular and other systems proceeds, and as each little fish acquires greater powers of locomotion, the fins most used in balancing increase in size. Thus the pectorals of the young salmon, cod, haddock, whiting, and especially the gurnard are disproportionately large in the succeeding stage, probably because such enables them to capture their pelagic prey more readily and with greater certainty. Their heads and eyes are also comparatively large.

In connexion with the development of the fins it is interesting that some pelagic fishes, whose habits at present are vaguely known, are remarkable for certain peculiarities in their fins. Thus, in the oar-fish (*Regalecus Banksii*) the pectorals are of moderate size, while the slender ventrals are enormously elongated and tipped with a flattened blade, so that in outline they somewhat resemble a painter's maul-stick. It is not known whether the fish uses these as tactile organs, as the hump-backed whale is said to use its great flippers, to avoid being beached, or otherwise; but they would appear to form an efficient means for sounding the distance from the bottom or other solid structure.

Now a remarkable change takes place in the fins of two well-known fishes, one of which is of considerable commercial importance, viz. the ling; and further examination will probably reveal a similar condition in other forms, such as the cod. Indeed Alex. Agassiz * figures a young fish with attenuate and elongate ventrals, and which he conjectures to be a young cod.

After the early tadpole-stage of the ling already mentioned, and in which it corresponds in outline with the young of other food-fishes, though it is differentiated by peculiar dull yellow pigment, it seeks its way downward as it grows larger.

* Proc. Amer. Acad. Nat. Sc. xvii. p. 296, pl. viii. figs. 4 and 5.

Thus it is found at a depth of 25 fathoms on 32-fathom ground (*i. e.* about 7 fathoms from the bottom) as a little fish having the form of the adult but with a pair of enormous ventral fins (like those of the young sword-fish *) of a deep yellow colour, the only remnant of the tint so characteristic of the tadpole-stage. It would appear to be a truly pelagic stage of a bottom fish, for it is doubtful if the long ventrals would be of much use to an active fish that seeks its prey on or near the ground. The other larval fish characterized by long ventrals is the rockling †, and it is noteworthy that these are likewise conspicuously coloured, being white at the base and black at the tip. The rockling, like the ling, haunts the bottom in adult life, while it is truly pelagic in its larval stages. Too little is yet known in regard to the influence of such elongate ventrals on the habits of these young fishes to enable a correct judgment to be formed; but it would appear to be, in part at least, connected with their more active existence. In the same way the huge pectorals of the larval gurnard (which cause it to mimic the flying gurnard) can be explained. An analogous condition is seen even in the pectorals of the larval catfish (in which, of course, ventrals are entirely absent), and their tails are also proportionally larger than in the adult, thus enabling them to mount readily through a considerable stratum of water, though they are hatched on the bottom and ultimately live there. In estimating the influence of such modified organs it is well to bear in mind that at a later stage and with much shorter fins certain fishes, such as the cod and haddock, procure similar (pelagic) food, but at a distance from the surface and in the midst of different currents. Their muscular systems, however, are much more largely developed ‡.

The special bearings of the wealth of pelagic life on the nourishment of the young food-fishes now fall to be considered.

* In this stage the little ling at first sight approaches the condition in the forked hake, for which Mr. Calderwood and I for a moment took it. The larval angler also shows huge ventrals, while in the adult they are small. The dory, again, has long ventrals in its adult stage.

† First pointed out by Alex. Agassiz in a form which he doubtfully referred to *Motella argentea* (Proc. Amer. Acad. of Arts & Sci. vol. xvii. p. 294, pl. vii.).

‡ Zoologists had been so accustomed to consider the greatest wonders of the sea to be on the bottom that the novelties in the superincumbent water had been somewhat under-estimated. Yet it is only in the latter region that the mysteries still present in the life-histories of many of the food-fishes can be unravelled and the direct and indirect influences exercised by other pelagic forms on their growth duly appreciated. It is in this connexion that the huge mid-water net attached to the large triangle (*vide* Ann. & Mag. Nat. Hist. for Oct. 1886, p. 310) will be of real service to science.

On glancing at the various forms of pelagic animals it is found that both those which are *temporarily* and those which are *permanently* pelagic are important factors in the food of fishes. The temporarily pelagic include such forms as larval stages of sponges, hydromedusæ, and larval cœlenterates, larval stages of starfishes, annelids, crustaceans, molluscoids, and mollusks, as well as the ova and young of fishes. The other or permanently pelagic group may be represented by the ctenophores, certain medusæ, copepods, schizopods, and other crustaceans, *Tomopteris* and other annelids, pteropods, certain cephalopods, and fishes. Some of the small forms, such as diatoms, Infusoria, larval medusæ, and starfishes, are rare in the stomachs of the minute food-fishes; but still the first two are occasionally found there. Moreover they are devoured by the crustaceans and mollusks, which subsequently nourish the fishes. Two groups especially stand out as universally distributed constituents of the food of the young fishes, viz. the crustaceans and the mollusks. The former is by far the most general at a very early stage; the latter is more characteristic of the later stages.

It is an interesting fact that at the time when the pelagic ova give birth to the young food-fishes the ocean especially abounds with the minute forms of the Crustacea, such as young copepods and the larvæ of other groups *. As soon as the yolk-sac is absorbed, and even before it is wholly absorbed, the most minute (almost microscopic) specimens of such crustaceans are found in the stomachs of the little fishes. Moreover this food is almost universal, for not only the young of the round and flat fishes (which keep up the relish for crustaceans in adult life), but the young of such forms as *Cyclopterus lumpus*, which, when full-grown, rarely feeds on crustaceans, and the young of *Lophius piscatorius*, which is strictly a destroyer of fishes in after life, follow the same habit. Nor is this food confined to their sojourn near the surface. As they grow older they descend to the lower water, where the same nourishment abounds, and there the young cod, haddock, whiting, ling, gurnard, and others disport themselves in the unceasing pursuit. The young flat-fishes accompany them, still swimming on edge and with an eye on each side, but being readily recognized by certain peculiarities, amongst which is the greater depth of the body. The nature of the food in many cases is indeed recognized with tolerable certainty at first sight, since in the more advanced larvæ the crustaceans (e. g. *Calanus finmarchicus*) tint the under surface of the translucent abdomen of a delicate pinkish hue.

* In this respect there is a parallelism with the atmosphere and insect-life in summer and autumn.

It is probably the profusion of crustacean life close inshore that tempts the shoals of green cod, common cod, whiting, and pollack to seek the rock-pools and inlets at low water; there they pursue their active prey amongst the olive-green seaweeds and forests of tangles, and likewise seize on many of the smaller Mollusca browsing on the algæ. These large forms also to a considerable extent feed on the young mussels just as they are quitting pelagic life to fix themselves by their byssi to the seaweeds, zoophytes, and rocky surfaces; and no food is more eagerly sought after or is more nourishing than this. Their enormous numbers, for instance in St. Andrews Bay, make them important elements in the food of the younger fishes; and though perhaps their presence is not so vital as that of the minute crustaceans in the early larval stage, still any serious injury to the fine mussel-beds of the Eden or of the Tay would be detrimental to the prosperity of the fisheries. Man has this much in his power; but he is impotent in regard to the vast and never-failing supply of minute crustaceans and other forms which Nature provides in the open sea for the sustenance of the delicate and translucent young of the food-fishes. No ordinary atmospheric change can materially modify this wealth of pelagic life, though it is true that in some seasons its appearance and that of the young fishes which prey on it may be slightly varied.

The importance of the pelagic element in the food of our fishes cannot readily be over-estimated. Without it the young fishes, after the absorption of the yolk-sac, would become emaciated and perish. Moreover the minute size of certain of the constituent forms is eminently adapted for the needs of the most tiny fishes; while the adults of the same crustaceans, or those of more bulky species, fit in as suitable sustenance of young fishes of larger size. The interchange, again, taking place between the bottom-fauna and the surface, viz. of eggs and early larvæ passing upward, and of older forms going downward, keeps up a constant stream of food for the young fishes, which have a similar migration. But they do not, unmolested, thus levy a tax on the lower types. The larger food-fishes prey perpetually on the smaller; indeed certain stages in the development of the rarer fishes have hitherto been procured only from the stomachs of predaceous pelagic fishes, such as the various tunnies. In the same way early stages of haddock, whiting, and herring drop from the mouths of cod when landed on deck from the trawl. Thus a check is kept on the enormous powers of reproduction so characteristic of the food-fishes—powers of reproduction which have hitherto been, and doubtless will continue to be, of great benefit to man.

XVII.—*Description of a new Papuan Phalanger.* By OLDFIELD THOMAS.

Pseudochirus Forbesi, sp. n.

Externally almost precisely similar in size and colour to *Ps. canescens*, Waterh. *, but with no dark central streak on the head, with a large black patch in front of as well as behind the ear, with the ears themselves more thickly haired and surrounded by tufts of long soft hairs, and with the tail much more thinly haired, especially on its distal half.

Skull differing from that of *Ps. canescens* by its smaller and lighter build, flattened instead of vaulted nasals, more concave forehead, stronger supraorbital ridges, forming rudimentary postorbital processes, corresponding to which there is a marked prominence on the upperside of the malar bone.

Teeth, on the whole, small and light. Molars of about the same size as in *Ps. Bernsteini*, but the anterior teeth remarkably reduced, the incisors, canine, and posterior premolars very small, while the third incisor and first premolar are altogether suppressed, the upper dental formula being therefore

$$\text{I. } 2, \text{ C. } 1, \text{ PM. } 2, \text{ M. } 4, \times 2 = 18,$$

a formula quite unique in the family.

Below, the rudimentary teeth between $i.^{1}$ and $pm.^{4}$ are wholly absent in one jaw, while in the other there is the alveolus from which a single minute tooth has been lost.

Dimensions of the type, an adult male (skin):—

Head and body (c.) 280 millim., tail 230, hind foot 30, ear (c.) 13, naked part of tail (c.) 100.

Skull: basal length 47·7 millim., greatest breadth 30·0; length of first three molars 8·8, vertical length of $i.^{1}$ 3·3.

Habitat. Sogere, Astrolabe Mountains, South-east New Guinea, 2000 feet altitude. Collected by H. O. Forbes, Esq.

The discovery of this highly interesting species is one of the results of Mr. H. O. Forbes's recent expedition to New Guinea, and I have very great pleasure in connecting his name with it.

Besides *Ps. canescens* the only other species allied to *Ps. Forbesi* is *Ps. Schlegeli*, Jent. †, which may, however, be readily distinguished from it by its wholly unstriped body, hairy underside of tail, vaulted nasals, more convex forehead, and very markedly larger teeth, among which $i.^{3}$ and $pm.^{1}$ are of course present.

Of this small group of Phalangers only five specimens are

* Figured by Hombron and Jacquinot, Voy. Pôle Sud, Zool. Atl. pl. xix. (1842–53). (= *Ps. Bernsteini*, Schl., figured by Peters and Doria, Ann. Mus. Genov. xvi. pl. xii. 1880.)

† Notes Leyd. Mus. vi. p. 110 (1884).

known, namely the type of *Ps. canescens* at Paris, of *Ps. Bernsteini* and *Schlegeli* at Leyden, the specimen figured by Peters and Doria as *Ps. Bernsteini* at Genoa, and that now described as *Ps. Forbesi*. All these specimens I have myself examined and compared directly with one another; and for this advantage I have most sincerely to thank Prof. Pouchet, of the Paris Museum (Anatomie Comparée), and the Marquis G. Doria, of Genoa, both of whom sent me the valuable specimens under their respective charges, and Dr. F. A. Jentink of Leyden, by whom I was kindly permitted to study those there preserved.

XVIII.—*Diagnoses of two new Fruit-eating Bats from the Solomon Islands.* By OLDFIELD THOMAS.

Nesonycteris Woodfordi, g. et sp. n.

Very similar, both in external and cranial characters, to *Melonycteris melanops*, Dobs.*, but with the face and whole of underside uniformly rufous, like the back, instead of being variegated with black and white, with no white spot at the insertion of the wing-membrane, with a longer slenderer muzzle and shorter smaller ears, without any trace of a claw on the index-finger, and, finally, with only one instead of two incisors on each side of the lower jaw.

Dimensions of an adult male (skin):—Head and body (c.) 100 millim.; head 35; muzzle 15·0; ear (from notch at base) 11·0; forearm 55·0.

Hab. Shortland and Fauro Islands, western part of Solomon group.

Two adult skins (male and female), and a young specimen in spirit, of this highly interesting bat were obtained, together with a considerable number of other Solomon-Island animals, in April and May 1886 by Mr. C. M. Woodford, after whom, as its discoverer, I have considered it only fitting to name the species.

Pteropus grandis, sp. n.

Size large; ears long and pointed; interfemoral membrane very narrow in the centre, concealed by the fur. Face, back, and centre line of belly black; neck, throat, and sides of body below dark maroon-red; rump and back of tibiæ rich orange-yellow.

Length of forearm (♂) 170 millim.

Hab. Shortland Island (*C. M. Woodford*).

* P. Z. S. 1877, p. 119, pl. xvii.

XIX.—*On new Fishes from the Lower Congo.* By G. A. Boulenger.

The Trustees of the British Museum have recently acquired some fishes collected by M. F. Hens on the Lower Congo, among which are three undescribed species. In addition to these the three following are of interest as new to the fish-fauna of the Congo, or at least not recorded in Dr. Sauvage's recent list in Bull. Soc. Zool. France, 1884, pp. 201, 202:—

Chromis Dumerilii, Stdr.; *Channallabes apus*, Gthr.; and *Polypterus palmas*, Ayres.

Ctenopoma congicum.

D. 17/8. A. 11/10. L. lat. 27. L. tr. $\frac{3}{8}$.

The depth of the body is one third of the total length (without caudal), the length of the head three tenths. Diameter of the eye greater than the length of the snout, two sevenths the length of the head. Operculum terminating in two processes, the upper with four or five spines, the lower with one, separated by a non-serrated crescentic notch; suboperculum strongly serrated. Four series of scales between the orbit and the angle of the præoperculum. The soft rays of the vertical fins covered with small scales, the ctenoid character of which is strongly marked. The pectoral reaches to below the fourteenth perforated scale of the lateral line. Outer soft ray of the pectoral produced, filiform, extending to the base of the penultimate anal spine. Blackish brown, with light spots on the lower half of the body and on the tail.

Total length 70 millim.

Native name "Kouendé." Inhabits the lagunas in the islands of the Lower Congo, and is never found in the river itself (*F. Hens*).

Clarias melas.

D. 105. A. 88. P. 1/7.

Caudal fin united with dorsal and anal. Vomerine teeth villiform, forming a crescentric band, which in its middle is a little narrower than that of the præmaxillaries; the band of mandibular teeth is a little broader than that of the præmaxillaries and likewise composed of villiform teeth. Head finely rugose above, its length to the end of the occipital process one sixth of the total (without caudal); the height of the body one tenth. Occipital process acute. The width of the head

between the gill-openings is two thirds of its length (to the end of the occipital process), its width between the eyes three eighths. The nasal barbel extends to the gill-opening, the maxillary and the outer mandibular to the end of the pectoral spine. Pectoral very small, two fifths the length of the head; its spine strongly serrated on the inner edge, feebly on the outer, two thirds the length of the fin. Ventrals very small, in the anterior third of the total length. Uniform blackish brown.

Total length 260 millim.

A transition-form between *Clarias* and *Gymnallabes.*

Native name "Fouca." Lives in the lagunas and marshes of the Lower Congo; is often found in holes in the mud during the dry season. The species reaches twice the size of the type specimen (*F. Hens*).

Mormyrus (*Petrocephalus*) *Sauvagii.*

D. 29. A. 36. V. 6. L. lat. 40.

Snout very short, elevated, one sixth the length of the head, shorter than the diameter of the eye. Cleft of the mouth below the vertical from the front margin of the eye, its width two sevenths of the length of the head. Teeth comparatively large, dilated and notched, forming a complete series round the margin of both jaws. Diameter of the eye somewhat more than one fifth of the length of the head, three fourths the width of the interorbital space. The origin of the dorsal is equally distant from the occiput and the root of the caudal. The pectoral equals the distance between the eye and the gill-opening and extends a little beyond the base of the ventral, which is not quite one third as long as the head. The height of the body is contained thrice in the total length (without caudal), the length of the head thrice and two thirds. The length of the caudal peduncle (from the extremity of the base of the anal) equals three fifths the length of the head, or two thirds the length of the dorsal. Plumbeous, without any spots.

Total length 175 millim.

Allied to *M. bane*, Lacép., but easily distinguished by the still shorter snout, the larger mouth, and the stronger dentition.

Native name "Tembé." Found in the creeks of the Lower Congo and the tributary streams.

Named in honour of my friend Dr. H. E. Sauvage, who has added so much to our knowledge of the fishes of tropical Africa.

XX.—*Critical Notes on the Polyzoa.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

I PROPOSE in the present paper to discuss a number of miscellaneous points, structural and systematic, in the history of the Polyzoa, not according to any definite plan, but in such order as may be convenient.

1. Family **Adeoneæ**, Busk.
("Report on the 'Challenger' Polyzoa," pp. 177–189.)

Under the above name Busk, in his latest work *, has constituted a family group, in which are included a number of remarkable forms belonging to the genus *Adeona*, Lamouroux (*Dictyopora* of MacGillivray), and a somewhat heterogeneous company, many of whose members were distributed amongst the genera *Lepralia* and *Eschara* of the older writers. The group is divided into two sections:—(i.) the true *Adeonæ*, characterized (almost universally) by a fenestrate zoarium and a very curious flexible stem; and (ii.) forms agreeing generally with the above in zoœcial character, but destitute of the fenestrate structure and the stem. The old name *Adeona* is retained for the first, whilst that of *Adeonella* is assigned to the second.

The points which are noted by Busk as characteristic of the *whole family* are briefly these:—(i.) "the presence of three distinct forms of cell" (zoœcia, and oœcial and avicularian cells); (ii.) the absence of oœcia of the usual type, their function being discharged by specially modified zoœcia; (iii.) the presence of large avicularian cells; (iv.) a special pore (or a number of such pores) on the front of the cell-wall; and (v.) a peculiarity in the avicularian mandible, which is

* I cannot refer to Mr. Busk's work at the present time without expressing my deep sense of the services which he has rendered to all students of the Polyzoa, and of the loss which they have sustained by his death. Not only has he enriched the literature of the Class with a series of admirable works, embodying the results of much able investigation and a wide experience, but it is not too much to say that he has been mainly instrumental in preparing the ground for the present generation of workers by introducing definite principles and systematic order, and supplying a scheme of classification, which, though to a large extent artificial, has been an invaluable help to the student in the treatment of his material, and has largely facilitated and stimulated research.

It is a matter of sincere regret to me that the criticisms which I venture to offer on some of his later conclusions have been so long delayed, and that I lose in consequence the benefit of the candid consideration which he would have been sure to give them.

furnished with an "articular process" at each end of the base.

It may be added that (according to Busk) the special pore of the Adeoneæ is formed in "at least three distinct ways."

Without at present discussing the precise significance of these characters, it may be remarked that the differences in the pores are of very serious import, so serious indeed that these structures are by no means morphological equivalents throughout the series, and possibly have not the same function.

The *Adeonæ* are furnished with pores of substantially the same structure and exhibiting the same mode of development; the differences are only met with amongst the *Adeonellæ*; and there can, I think, be little doubt that they leave us no choice but to dismember this genus should it indeed be retained.

Coming now to a consideration of the diversities existing amongst the pores in this section of the Adeonidæ *, as defined by Busk, we find that two very distinct types occur—(i.) the pores are perforations of the main wall of the zoœcium, and open directly into its cavity; they are single or in companies, simple or stellate; or (ii.) they are openings in the elevated tubular peristome, placed immediately under the secondary orifice, and give access, not to the cavity of the cell but to the interior of the peristome at some distance above the primary orifice. The two structures just described have clearly a totally distinct morphological significance, and possibly have also a different function.

Of the species referred to *Adeonella* in the 'Challenger' Report a large proportion are furnished with peristomial openings, and cannot properly be associated in the same generic group with those which have true pores.

In a previous paper † I have described the peristomial opening as it occurs in *Adeonella fuegensis*, Busk, and pointed out the essential difference existing between it and the Microporellidan pore, which in my judgment is of the same general nature as that of the *Adeonæ*. Waters has also noted the difference between these structures and correctly appreciated its importance ‡. He proposes to retain the name *Adeonella* for such forms only as have a peristomial opening.

* I follow MacGillivray in adopting this form of the family name in preference to that employed by Busk.

† "Contributions towards Gen. Hist. of Mar. Pol., XII. Polyzoa from India," Ann. & Mag. Nat. Hist. for May 1884.

‡ "On the Use of the Avicularian Mandible in the Determination of the Cheilostomatous Bryozoa," Journ. R. Micr. Soc. ser. ii. vol. v. (1885).

As yet, however, this section of Busk's *Adeonella* has not been studied with sufficient thoroughness to admit of an accurate definition. Amongst the species which Waters refers to it one at least is an alien, *A. polystomella*, Reuss (*Pallasii*, Heller), which is, as I have already pointed out *, an undoubted *Schizoporella*. This species, which is furnished with a median sinus, is destitute of avicularian cells, and it is doubtful whether the cells lining the margin of the zoarium, which are somewhat larger than the other zoœcia, but exhibit no further peculiarity, have a claim to be accounted oœcial, or, as I propose to term the cells modified for reproductive purposes, *gonœcia*. The so-called pore is a gap in the extension of the peristome above the primary orifice, which is bridged over above by a calcareous bar uniting the two lateral aviculiferous prominences, and completing the secondary orifice. A similar form of peristomial opening occurs also in *Gephyrophora polymorpha*, Busk, and in other species. It has no special connexion with the family of the Adeonidæ.

The figures in the 'Challenger' Report show that there are several forms amongst the so-called *Adeonellæ* in which the orifice is distinctly sinuated; and it is stated that the commonest way in which the pore is formed is "by the constriction off of the lower part of the orifice, which in such cases is more or less deeply emarginate or sinuated" †. In the account of *Adeonella regularis*, Busk, which is furnished with a "bridge" and with the equivalent of a peristomial opening, we are told that "a very minute suboral pore is occasionally formed by the cutting away of a portion of the labial fissure" ‡.

The account leaves us in doubt whether this is more than an accidental thing. If the pore is not an essential part of the structure, I should be inclined to refer *A. regularis* to *Schizoporella*. So far I have examined no species in which the formation of the pore could be traced to a constriction of the sinus.

Waters (*loc. cit.*) has drawn attention to the occurrence of an oral sinus in some of the *Adeonellæ*, and emphasizes the importance of this character; but amongst the species which he has gathered into his restricted genus *Adeonella*, two (*A. intricaria* and *A. pectinata*) are described as having the lower margin of the orifice straight and entire. The mere presence of a peristomial opening can hardly be made the basis of a

* "The Polyzoa of the Adriatic," Ann. & Mag. Nat. Hist. for March 1886, p. 268, pl. x. fig. 7.

† 'Challenger' Report, 1884, p. 178.

‡ *Ibid.* p. 187.

genus. Further investigation of some of the 'Challenger' species will be needful before we can safely determine their systematic place.

An interesting question arises as to the relation between the families of the Adeonidæ and Microporellidæ.

Busk has placed them wide apart in the system; but the links between the true *Adeonæ* and the *Microporellæ* are (to say the least) far from unimportant, and if it should appear that, on the whole, there are grounds for referring them to distinct families, the affinities which connect them should be fully recognized in our classification. The shape of the orifice and the special suboral pore are important characters which they share in common. Busk, indeed, was of opinion that the pore of the *Adeonæ* "differs widely in nature from the lunate pore of *Microporella* &c." ('Report,' p. 178); but he has not stated the grounds of his opinion. Both of them are special openings into the cavity of the cell, and probably subservient to the same function. The mode of their development must be substantially the same. The pore of *Microporella* is in some cases lunate, in others round, in others again elongate; it is sometimes fimbriated, sometimes simple. The lunate form is due to the presence of a small rounded flap, which projects over the opening and partially closes it. This appendage is probably protective, like the marginal teeth, but has no peculiar significance. I can find nothing in the structure or development of the Microporellidan pore which indicates a difference in "nature" between it and the pore of the *Adeonæ*. The two are homologous structures, with the same general characteristics.

If we examine the points indicated by Busk as characteristic of the family of the Adeonidæ, with a view to determining their precise significance, we shall find, I think, that the presence of oœcial cells, or rather of cells specially modified for the discharge of the reproductive function (gonœcia), is the only one that is in any sense distinctive. The avicularian cells are far from uncommon, and are met with in many genera. In such a form as *Schizoporella serratimargo*, mihi, they bear the closest resemblance to those of *Adeona*. A familiar example of them is found in the British *Schizotheca fissa*, Busk.

The special pore, as I have shown, is essentially identical with that of *Microporella*. The peculiarity in the avicularian mandible could hardly be accounted a character of primary importance, even if it were confined to this family; but Waters has shown (*loc. cit.*) that it occurs in several species beyond its limits, which are referable to distinct genera. The

only character left, therefore, as the *peculium* of the Adeonidæ is the coexistence (generally) in the colonies of three forms of cell, of which the reproductive seems to be without an *exact* parallel amongst the Chilostomata.

But it must be noted that cases commonly occur in which the cell carrying the oœcium exceeds in size the ordinary zoœcium and is furnished (like the reproductive cell of the Adeonidæ) with a differently shaped orifice. This condition is strongly marked in such a species as *Schizoporella obliqua*, MacGillivray (sp.), in which there is a striking dissimilarity between the operculum of the ordinary zoœcium and that of the reproductive cell.

In *Schizoporella acuminata*, Hincks, the orifice of the gonœcium is about twice as large as that of the zoœcium, and assumes a different form. In cases of this kind, before the growth of the marsupium has commenced, the cells destined to discharge the reproductive function are known at once by their peculiarities of structure. In some species of *Stegano-porella* (*S. magnilabris* and *S. Neozelanica*) the structure of the gonœcial cell is materially modified, and there is no external marsupium.

We have here in a less degree the very specialization of the reproductive function which we find amongst the Adeo-nidæ. The development of a class of cells with a modified structure in which the generative products originate is by no means confined to a single family. The character is widely diffused and can hardly, even in its most distinctive form, be made the basis of a family group or warrant the sepa-ration of species which exhibit such an essential identity of zoœcial structure as the Microporellidæ and a large propor-tion of the Adeoneæ of Busk.

There is a strong case then for the union of the latter family with the Microporellidæ in a single group, on the ground that the essential characters of the zoœcium are the same in both, whilst the differences between them are of common occur-rence amongst the most nearly related forms. On the other hand, the remarkable specialization of the reproductive func-tion amongst some of the Adeonidæ, which is assigned in many of the species to groups of peculiarly-constituted cells (subcolonies), distinguished by their size, by the structure of the orifice, and by the enlarged system of pores for the more complete aeration (probably) of the generative products, and the entire suppression of the usual marsupial arrangement, are undoubtedly points of much interest, though not in my judgment of primary systematic importance.

In a large proportion of cases the clusters of reproductive

cells scattered over the surface of the zoarium are associated with a few of the gigantic avicularia, which are disposed around them as if for the purpose of defence. They constitute a striking and unique feature, and, perhaps, mark the climax of this sort of specialization amongst the Chilostomata.

The division then of the Adeonidæ which exhibits the zoœcial structure characteristic of the genus *Adeona* I should refer to the family Microporellidæ, in which two subsections may be distinguished:—(*a*) containing species which are destitute of gonœcia, but furnished with an external marsupium (type *Microporella*); (*b*) containing species which are destitute of oœcium, but possess (for the most part) gonœcial and avicularian cells (type *Adeona*).

This view is sustained by the high authority of Prof. Smitt. He places his *Escharipora mucronata*, which he ranks along with *Eschara lichenoides*, Busk (*not* M.-Edwards), and *Eschara distoma*, Busk, and *Porina subsulcata*, Smitt, which undoubtedly belong to *Adeonella*, Busk (restricted), in his family Eschariporidæ along with such forms as *Microporella ciliata* and *M. flabellum*, Busk. And in his account of *P. subsulcata* he says: "It is necessary very carefully here to distinguish the various forms, because in the neighbourhood of this species we have to place the interesting *Adeonæ*, and then to decide from which simpler form that curious growth is nearest to be derived." [' Floridan Bryozoa,' part 2, p. 29.] It is, perhaps, only fair to add that though he gives a precise account of the avicularian cells, Prof. Smitt's attention does not seem to have been specially directed to the gonœcia; but the fact remains that after a careful study of the zoœcial characters, he saw no reason for isolating *Adeona* from the Microporellidæ.

Waters has already* referred the species of *Adeona* and *Adeonella*, Busk (part.), which he has recorded from the Australian Tertiaries, to the genus *Microporella*, thus fully recognizing the affinities for which I contend, but, at the same time, rejecting (as I suppose) the genus *Adeona*. Apart however from mere variations in the habit of growth and adaptive modifications of less essential elements of structure, there may be found, I believe, a sufficient basis for a generic group in the remarkable distinction between the zoœcium and the reproductive cells and the entire absence of the oœcium which are characteristic of the *Adeonæ* of Lamouroux and Busk.

* "Chilostomatous Bryozoa from Muddy Creek, Victoria," Quart. Journ. Geol. Soc. for Aug. 1883, and "Chilostomatous Bryozoa from Aldinga and the River Murray Cliffs, South Australia," *ibid.* August 1885.

MacGillivray adopts the family Adeonidæ, as constituted by Busk, but adds nothing to the evidence in its behalf which I have just discussed *. He proposes the generic name *Adeonellopsis* for the section of Busk's *Adeonella* characterized by the presence of true pores, and assigns the species with a peristomial opening to the *Adeonella* of Waters. The latter, however, as I have already remarked, has not been strictly defined, and as at present understood includes in all probability very dissimilar forms. Of the 'Challenger' species referred to it [Waters, *loc. cit.*] *A. polymorpha* and *A. atlantica* must be accounted doubtful. I should certainly hesitate to place them at all without the opportunity of examining specimens. In the case of the latter the description is incomplete. *A. platalea* seems to be distinctly related to the Schizoporellidæ; the primary orifice is represented as deeply sinuated. The large spoon-shaped avicularium is a character which it shares with *S. spongites*, Smitt. The peristomial opening is not a distinctive feature. *A. intricaria* has a peristomial opening and an orifice with a straight lower margin, gonœcia, and avicularian cells. It is one of the forms which apparently must be separated from the Microporellidæ. *A. pectinata* must be placed amongst the doubtful forms. We have no account, as it seems, of the *primary* zoœcial orifice; the "mouth," described as having "the lower lip" straight, appears to be the secondary orifice; nor is it easy to understand "the reniform" pore placed low down on the "oœcial cells." The zoœcial pore is described as "sublabial," and must be a peristomial opening. The remaining species assigned by Waters to his genus *Adeonella* is *Schizoporella polystomella*, Reuss (= *S. Pallasii*, Heller), of which I have already spoken. There is clearly room for much further investigation of the forms referred to the genus *Adeonella*, Busk, in the 'Challenger' Report. *A. distoma* seems to be the only true Microporellidan included in it, so far as we are able to judge.

A question remains: Is there any sufficient ground for dividing the genus *Adeona*? Busk has shown † that the flexible stem is really the only character to which much importance can be attached that separates this form from *Adeonella*. The mere habit of growth would not count for much even if it were constant; but from Kirchenpauer's figures ‡ it appears that there are two species furnished with

* "Descriptions of new or little-known Polyzoa.—Part IX.," Trans. Royal Soc. Victoria, 1886.

† 'Challenger' Report, p. 183.

‡ "Ueber die Bryozoen-Gattung *Adeonia*," 1879, plate i. figs. 2, 3.

the flexible stem which have the simple habit of *Adeonella*. On the other hand, the stem is sometimes present and sometimes wanting in a fenestrate species, not yet described, but which Mr. Busk proposed to call *Adeona Gattyæ*. The zoœcial characters are alike in *Adeona* and *Adeonella* (restricted).

It must be borne in mind that there is no element of structure amongst the Polyzoa so liable to adaptive modifications as the so-called radical appendages. We meet with striking illustrations of this fact amongst the Cellulariidæ. In one and the same species the mode of attachment and the apparatus for effecting it exhibit the most remarkable differences. In the genus *Microporella* we have both crustaceous and erect bilaminate forms *. In the latter section *M. flabellaris*, Busk, and *M. marginata*, Krauss, are attached by means of a flexible stem or peduncle composed of many chitinous tubular strands; *M. hastigera*, Busk, a kindred species, affixes itself by an adherent stony base. The calcareo-chitinous peduncle of *Adeona*, with its numerous radical appendages, is a much more complex structure than the foregoing, in correlation with the large and massive foliaceous expansions of which the zoarium consists. It supplies great flexibility and great strength and secure anchorage. But there is a strict analogy between the two, and the greater complexity does not affect the systematic significance of the structure. Genetic affinity is most surely indicated by the essential characters of the individual zoœcium, and in these *Adeona* and *Adeonella* do not differ. That the mode of attachment would vary with local circumstances and the habit of colonial growth was to be expected, but the unity of the group is in no degree affected by the adaptive change in a mere structural detail. There is then, in my opinion, no warrant for dismembering the genus *Adeona*; the species composing it will range themselves naturally and conveniently under two heads: (1) with a flexible stem and (commonly) a fenestrate zoarium; (2) without a flexible stem.

For crustaceous forms, agreeing in essential character with *Adeona*, Busk has instituted the genus *Reptadeonella*, which is a return to a discredited principle of classification, and one which Mr. Busk himself has abandoned in other cases. The name is specially objectionable as it commemorates a discarded

* Busk, indeed, has instituted a genus for the latter (*Flustramorpha*); but the only distinctive character relied upon is the erect, bilaminate growth, which is absolutely immaterial. The chitinous stem and marginal tubes, which occur in *M. flabellaris* and *M. marginata*, it is admitted, have no generic significance, as "a similar condition obtains in species belonging to widely distinct genera" ('Challenger' Report, p. 135). It is very desirable, in the interest of a natural system, that such spurious genera should be weeded out.

doctrine, and emphasizes a point which has lost the systematic value it once possessed.

The only permanently crustaceous *Adeona* with which I am acquainted is the British species *A. violacea*. It shows unmistakably its affinity to *Microporella*, but is furnished with gonœcia and is destitute of the oœcium. Avicularian cells are wanting, and the reproductive cells exhibit a somewhat lower degree of specialization than we meet with amongst the fenestrate and branching forms. They are scattered over the colony singly or in pairs (occasionally in larger number), are about twice as large as the zoœcia, slightly convex, and furnished with a narrow, transversely elongate orifice. So far as I have observed, however, there is little or no increase in the number of pores. Rarely two are met with instead of one, as in the zoœcia; but more generally there seems to be no increase of number, though the size of the pore is much greater. In the remarkable variety, however, which I have described and figured from the Channel Islands * there are two pores in the zoœcia, and in the reproductive cells three or (commonly) four of considerable size †.

2. Family **Membraniporidæ.**

Membranipora radicifera, Hincks.

In this curious species the structure conforms to the Membraniporidan type, but the mode in which the zoarium is attached bears a general resemblance to that which prevails amongst the Cellulariidæ and Bicellariidæ. A large number of tubular fibres is emitted from the inferior surface of each cell, so that the base of the zoarium is completely covered and concealed by the multitude of these root-like appendages, which penetrate into the ooze over which the polyzoon spreads, and attaching themselves to fragments of shell, stone, &c., hold it to its place. The adaptive modification is extremely interesting, but, like the flexible stem of *Adeona*, it has no special systematic value. We already know of one or two similar cases, and probably many more exist ‡. But another peculiarity (which is shared by the two species mentioned in the footnote) has been observed in *M. radicifera* §. Its cells are partially disjunct, each of them is connected with the

* Hist. Brit. Mar. Polyzoa, p. 216, pl. xxx. fig. 3.

† The differences between the var. and the normal *A. violacea* are so important that I believe it should rank as a species.

‡ I have described a similar structure in *Cribrilina ferox*, MacG., and *Schizoporella argentea*, Hincks (" Contributions Gen. Hist. Marine Polyzoa," 'Annals' for July 1881 and March 1885.

§ "Contributions" &c., 'Annals' for July 1881.

neighbouring cells by six short processes or extensions of its wall, and these connecting bands, though not absolutely isolated from one another, are separated by a deep depression. So that we have a first step towards the retiform condition which is characteristic of such a form as *Diachoris*, Busk. On the strength of this structural peculiarity MacGillivray, in a recent part of his important work on the Polyzoa of Victoria, transfers this species to the genus *Beania* (which he identifies with *Diachoris*). In support of this view he points out that its avicularium is also transitional and marks an advance towards the capitate form which distinguishes the Bicellarian family. But *M. radicifera*, whatever its transitional tendencies, is still a characteristic *Membranipora*. If it shows us a possible road from the one type of structure to the other, it has not itself joined the Bicellarian camp. Its cells are still united in a solid zoarium; its avicularium, though suggestive of change, has not reached the articulate goal, but remains fast soldered to its place and as incapable of movement as the most rudimentary appendage. It is not, I respectfully submit, permissible to sever it from the tribe to which its actual characteristics ally it, and transfer it to one towards which at most it has only a few structural leanings. Its partially disjunct cells and its avicularium, simulating the bird's-head form, are interesting as genealogical hints, but they are nothing more.

Diachoris (or *Beania*) is a true Bicellarian, with the chitino-membranous, boat-shaped cell of a *Bugula*, and the highly organized capitate and articulated avicularium so characteristic of that family. The reticulate structure of its zoarium is after all its least significant character; its place is determined by the essential structure of its zoœcium, and, so far as this is concerned, it has little in common with the present species.

3. Family **Membraniporidæ** (*continued*).

Notes on the Genera.

There is no more natural group amongst the Polyzoa than the *Membraniporæ*, in which the primitive membranous covering of the cell endures, either wholly or in great part, as a permanent character. It embraces an immense number of species, and, as a matter of convenience, it would be desirable to break it up into subgroups, if any natural basis could be found for them. But important modifications of the typical characters are rare, and of the subdivisions that have been proposed a considerable proportion are purely artificial. In his

'Challenger' Report Busk includes four genera in the Membraniporidan family. Of these *Amphiblestrum* and *Biflustra* can hardly be regarded as anything but arbitrary groups; *Foveolaria* seems to have a claim to rank as a distinct genus. The section of the genus *Membranipora* of which *M. pilosa* is the type is classed as a family (Electrinidæ), containing a single genus, *Electra*, Lamouroux. This is an important change, and seems to be justified by the very striking peculiarities of the type. It may perhaps be a question whether the new 'Challenger' species *Electra cylindracea* is entitled to a place in the genus. The absence of an oœcium seems to be characteristic of the other species referred to it.

MacGillivray has instituted the genus *Thairopora* for Membraniporidan forms in which the orifice is surrounded by a border and is closed by an operculum which works on a distinct hinge. There can be no doubt that this is rightly accounted an important structural change, and a good foundation for a generic group. I am unable, however, to agree with Mr. MacGillivray when he refers *Micropora Jervoisii*, Hincks, to his new genus *. It has the front wall completely calcified and shows the other characters which distinguish the genus *Micropora* †.

4. Family **Microporidæ**, Smitt (part.).

Membraniporidæ, Busk, B. M. Cat. (part.).
Microporidæ, 'Challenger' Report (part.); Hincks, Brit. Mar. Pol. (part.).

In this family the calcification of the front wall is complete and the operculum rests upon a stony framework, which forms a border round it. It shares the depressed area and raised margins with *Membranipora*. One or two very different types of structure have been included in this group. Smitt referred to it both *Micropora* and *Steganoporella*, and I at one time took the same view. But I am now convinced that the forms which are furnished with what Dr. J. Jullien has termed the "double ectocyst" must be separated from *Micropora*, and are entitled to stand as a distinct family group. Dr. Jullien's contention ‡ that this peculiarity is of such significance as to warrant the distribution of the Chilostomata into two great tribes—those which possess it and those which do not—I am by no means prepared to admit. But there can be no doubt that it has a high morphological interest as a very distinct

* "New or little-known Polyzoa.—Part XI.," Trans. Roy. Soc. Victoria, 1886.

† "Contributions" &c., 'Annals' for February 1882.

‡ "Note sur une nouvelle division des Bryozoaires Cheilostomiens," Bull. de la Soc. Zool. de France, t. vi. (1881).

form of structure, and should be recognized as such in our system.

Busk (in the 'Challenger' Report) has included in the present family *Micropora*, *Steganoporella*, and a genus *Vincularia*, of which a cylindrical habit of growth is an essential character, and which in other respects is represented as being somewhat intermediate between *Micropora* and *Steganoporella*. The peculiar habit of growth (as Mr. Busk has elsewhere virtually admitted) is of no account whatever as an indication of affinity; and it would probably be better that such a name as *Vincularia*, which inevitably suggests cylindrical form, and little but this, should disappear from our nomenclature. *Vincularia gothica* of the 'Report' is furnished with the "double ectocyst," and will probably find a place in the same family as *Steganoporella* and its allies.

In the family of the Microporidæ such forms only must be included as agree in general structure with the well-known and widely distributed *Micropora coriacea*, Esper.

Fam. char.—*Zoœcia* with raised margins; *front wall* depressed, wholly calcified; *orifice* enclosed by a calcareous border, operculum with a distinct hinge.

The species of *Micropora* are invested by a membranous epitheca, which seems to be composed of comparatively stout and durable material, and is more persistent than is usual amongst the Polyzoa. A characteristic feature is the foramen on each side of the front wall a little below the orifice.

Amongst the forms which are furnished with the "double ectocyst" (some of which have hitherto ranked amongst the Microporidæ) are the species comprised in the genus *Steganoporella*, Smitt, *Membranipora antiqua*, Busk, and one or two kindred species described by Jullien, *Vincularia abyssicola*, Smitt, *Caleschara denticulata*, MacG., and *Diplopora cincta*, Hutton. In all these forms the front wall of the cell is simply membranous; it carries the oral opening and the operculum. At a greater or less distance below this membranous covering a calcareous lamina is interposed, which divides the cavity of the cell into two compartments, an upper and an under; the lower or aboral chamber contains the polypide, the use of the upper has not been determined. At the upper end of the calcareous lamina there is a large opening (*opesia* of Jullien) by means of which the two chambers are brought into communication and through which the polypide finds access to the orifice of the cell. The opesia is always of much larger size than the orifice and variable in shape.

The species characterized by the structure just described may rank as a single family, to which it is probably right that the name *Steganoporellidæ* should be assigned, Smitt

having founded his genus *Steganoporella* on the dithalamic condition of the zoœcium *.

It would be pleasant to associate Dr. Jullien with this group, which he has so ably investigated, by adopting his name Onychocellidæ; but the scope of this family is much more restricted than that of the division which I propose, and further it is mainly based on a character (the structure of the avicularia) to which I find myself unable to attach the significance which he does.

5. Family **Steganoporellidæ.**

Fam. char.—*Zoœcia* closed by a membranous wall which carries the orifice and operculum, divided by a horizontal calcareous lamina, with a large variously-shaped opening (opesia) at the upper end, into two compartments, in the lower of which the polypide is lodged.

In the family thus constituted two principal groups are distinguishable. In one the aboral chamber is simple and undivided; in the other the inferior portion of it is shut off by a diaphragm from the upper, with which it communicates by means of a tubular passage; and in this lowest room of the somewhat complex structure the polypide is lodged. Of the first group we have a typical member in *Membranipora antiqua*, Busk (*Onychocella antiqua*, Jullien), whilst the second is well represented by *Membranipora magnilabris*, Busk (*Steganoporella magnilabris*, Smitt).

In the second division, however, it will be necessary to create two genera, for there are important structural differences between such species as *S. magnilabris* and *S. Neozelanica*, Busk, and *S. Rozieri*, Audouin (sp.), which have hitherto been included in the same generic group.

In *S. magnilabris* † the whole of the upper half of the cell forms in fact one large cavity, part of it above and part below the opesia, which is closed in by the very large operculum and the membranous front wall connected with it.

The tubular orifice of the polypide-cell opens out within the infra-laminar compartment, and a broad, shield-like denticle rises in front of it. But in *S. Rozieri*, Audouin (sp.), and allied species this denticular process is continued upwards, and unites with the margin of the cell, thus forming an orifice with a thickened rim, arched above and produced below. The upper half of this orifice (which is a kind of second opening to the polypide-cell) is closed by the operculum; the lower half remains open, but is overspread by the membranous front wall. By the structural modification just

* 'Floridan Bryozoa,' part 2, page 15.

† 'British Museum Catalogue' (Busk), pl. lxv. fig. 4.

described the opesia is to a considerable extent concealed when the front wall is removed, and is represented by a large foramen on each side of the calcareous plate, supporting the orifice; whereas in *S. magnilabris* both opesia and the cavity of the cell below it lie open *.

These differences in the cell are connected with important differences in the oœcial arrangements. In *S. magnilabris* there is no external ovicell, but its place is probably filled by a large internal chamber. The section to which *S. Rozieri* belongs is remarkable for the size of its bilobate oœcia, closed in front by a movable lid. For the section of the Steganoporellidæ represented by *Membr. antiqua*, Busk, Dr. Jullien's name *Smittipora* may be adopted, but with a wider application than he has given to it. The differences between this genus and his *Onychocella* are, in my judgment, of slight importance, and the two groups, which agree in all essential characters, may be united under one name.

For the *magnilabris* section, Smitt's *Steganoporella* will be the proper designation. For the *Rozieri* division I propose the name *Thalamoporella*. The development of the cell in this genus can be well traced at the growing extremities of the branches in an erect and cylindrical form of *T. Rozieri*, form *gothica*, which I have received from California. In the earliest stage the zoœcium is a simple oblong box of considerable depth, closed in above by a delicate and transparent membrane. There is no sign whatever of the oral valve, nor any trace of the internal lamina. In a more advanced stage an arch of rather deeper horn-colour than the surrounding membrane makes its appearance at the top of the front wall; this gradually becomes more pronounced, and at last the lower margin, completing the oral semicircle, is faintly outlined below it. In adult cells the margin round the orifice becomes thicker, and is slightly produced at the articular angles.

The operculum resembles in structure that of the Membraniporidan genus *Thairopora*, MacG. In the younger zoœcia there is no trace of any internal structure; the growth of the lamina commences later on at the lower extremity of the cell.

Besides the forms already mentioned, the *Caleschara* of MacGillivray † belongs to the Steganoporellidæ. Avicularia seem to be wanting, and it is furnished with oœcia of the ordinary type. It is nearly allied to *Smittipora*, if not a member of that genus.

Another species which must be referred to this family is the

* I hope to give figures illustrating the structural differences in a future paper.

† 'Zoology of Victoria,' dec. v. p. 45.

Diplopora cincta, Hutton, but its precise place I am unable to discuss at present.

The following table shows the arrangement of the Steganoporellidæ which I propose:—

Family **Steganoporellidæ.**

Genus Smittipora, Jullien.

Zoœcia with the lower compartment (situated beneath the calcareous lamina) undivided.

Type: *S. abyssicola*, Smitt.

Genus Steganoporella, Smitt (part.).

Zoœcia with the aboral compartment divided into two chambers by a diaphragm, the lower of which is connected by a tubular passage with the upper and contains the polypide; the whole of the upper half of the cell forming a large cavity, closed in by the operculum and membranous front wall. Operculum very large. External oœcia wanting; represented by an internal chamber.

Type: *S. magnilabris*, Busk.

Genus Thalamoporella, n. gen.

Zoœcia with the lower compartment divided; from the centre of the anterior extremity of the lamina a narrow calcareous wall is carried up to a level with the margin of the cell, to which it is united, forming an orifice, which is partially closed by the operculum; on each side of it a large foramen. Operculum small, semicircular. *Oœcia* external, bilobate.

Type: *T. Rozieri*, Audouin.

MISCELLANEOUS.

On the Class Podostomata, a Group embracing the Merostomata and Trilobites. By A. S. Packard.

In a paper read in November 1885 before the National Academy of Sciences we have endeavoured, by giving the history of the Xiphosura, Pœcilopoda, and Gigantostraca, to show that while the name Xiphosura should be retained for the suborder of which *Limulus* is the type, the names Pœcilopoda and Gigantostraca have been applied in such different senses that they cannot well be retained for the Merostomata and Trilobita taken together in the sense we advocate. We have therefore proposed the term Podostomata for this class of Arthropoda. It is derived from ποῦς, ποδὸς, foot, and στόμα, mouth, in allusion to the foot-like or ambulatory

nature of the cephalic appendages which surround the mouth in a manner characteristic of the group.

The class Podostomata may be defined as a group of marine Arthropods in which the cephalic (*Limulus*) or cephalothoracic (Trilobites) appendages are in the form of legs, *i. e.* ambulatory appendages, usually ending in forceps or larger claws (chelæ), which in the sole living representative of the class are arranged in an incomplete circle around the mouth; the basal joint of each leg is spiny, so as to aid in the retention and partial mastication of the food. No functional antennæ, mandibles, or maxillæ. Eyes both compound and simple. Respiration by branchiæ attached to the abdominal appendages, which are broad and lamellate in Merostomata, and cylindrical, with narrow gills, in Trilobita. The brain supplying nerves to the eyes alone; the nerves to the cephalic or cephalothoracic appendages originating from an œsophageal ring; the ventral cord ensheathed by a ventral arterial system more perfectly developed than in insects or scorpions. Coxal glands highly developed, with no external opening in the adult. The class differs from the Arachnida, among other characters, in having no functional cheliceres ("mandibles") or pedipalps ("maxillæ"); in the cephalic appendages either ending in larger claws or forceps, or in being simple, the terminal joint not bearing a pair of minute claws or ungues like those of Arachnida and Insecta, enabling their possessors to climb as well as walk. Podostomata have no urinary tubes. *Limulus* undergoes a slight metamorphosis, while in Trilobites the adult differs from the larva in having a greater number of thoracic segments.

From the Crustacea the Podostomata differ in the lack of functional antennæ and mouth-parts, in the compound eyes having no rods or cones, in the brain innervating the eyes (compound and simple) alone, in the shape of the head and pygidium or abdominal shield, and in the arterial coat completely enveloping the central nervous cord.

The Podostomata are divided into two orders:—

I. *Merostomata*, with three suborders: { *Xiphosura.* / *Synxiphosura.* / *Eurypterida.* }

II. *Trilobita.*

On the Anatomy and Classification of the Phytopti. By Dr. Alfred Nalepa.

The cephalothorax of the Gall-mites is unusually reduced, the abdomen, on the contrary, considerably extended and annulated. Besides the organs of the mouth the former bears only *two* distinctly quinquearticulate pairs of legs. The mouth-organs have the form of a more or less strongly bent rostrum. The stilettiform cheliceræ lie in a sucking-tube formed by the maxillæ, which is supported by the labium. The maxillary palpi are four-jointed, only the basal joint is amalgamated with the maxilla. At the extremity of the abdomen on each side of the anus there are two semilunar retrac-

tile plates, which serve sometimes to push the animal forwards, sometimes for attachment. At the base of the mouth-tube commences the narrow œsophagus, which traverses the nervous centre, and immediately after passing through this becomes widened into the gastro-intestinal tube. Pyriform glandular organs are appended to the narrow rectum. On each side of the nervous centre are the salivary glands, conglomerated unicellular glands. The sexual organs are unpaired. The sexual apertures are situated immediately behind the last pair of legs. In the male the sexual aperture appears as a fissure surrounded by swollen margins and with a supporting plate; in the female it is closed by a superior and an inferior opercular plate. The eggs and spermatoblast are developed from a single germinal layer. In the male animal this is sharply separated from the ducts and has a cylindrical form. Before the germinal layer there is a spherical dilatation of the seminal duct lined with glandular epithelium. The sperm-cells are very small, rounded cells. On each side of the female sexual aperture opens a small glandular organ (seminal pouch?). The rudiments of the sexual organs appear in the larvæ at first as solid cylindrical cell-bodies, the development of which has proceeded so far before the last moult that it is already possible to distinguish the sexes. The nervous centre is represented by a comparatively large, cylindrical ganglion; from its anterior part issue eight, and from its posterior part two nerves. To the present time the Gall-mites of twenty-four species have been closely investigated. On *Carpinus* I have found forms the abdomen of which is covered dorsally with shield-shaped half-rings. On *Populus nigra* Herr P. Olschar collected deformed buds exactly like those of *P. tremula*, and which, I believe, have not yet been described.—*Anzeiger Acad. Wiss. Wien*, 18th November, 1886, p. 220.

On the Conodonts. By MM. J. V. Rohon and K. A. von Zittel.

The curious minute fossils originally described by Pander under the name of Conodonts, and which he supposed to be the teeth of cartilaginous fishes of Silurian times, have been referred by subsequent authors to various types of organisms. They have been regarded as fragments of crustaceans, as the teeth of fishes allied to *Myxine* and *Petromyzon*, and as spines and teeth of naked Mollusca and Annelids. Dr. Hinde, who described many forms of these fossils from Silurian and later rocks, subsequently identified some of Pander's species with Annelid jaws.

The authors have discussed the question of the true nature of these problematical little fossils in considerable detail, and have described and figured their minute structure as made out by microscopical examination of thin sections, and summarize the results of their investigations in the following words:—"*All the forms consist of parallel-layered conical laminæ, arranged one over the other, and which are sometimes traversed by fine radial canals.*" They then proceed to a comparison of the structures recognized by them with those displayed by the various recent objects with which the Conodonts

have been identified, and from this arrive at the conclusion that they present the closest resemblance to the jaws of Annelids and of certain Gephyrea. They give a list of three simple and four composite forms of Conodonts described and figured by Pander, which they identify with Annelid jaws figured by Ehlers, finding an agreement between the fossil and recent forms not only in external, but also in histological characters. In connexion with this comparison the authors call attention to the fact that in the Annelids there is in both jaws an alternation of teeth of a simple conical form with those resembling the so-called composite Conodonts—that is to say, those in which the base of the organ is widened and bears two or more small points on each side of the large central cone. The Gephyrean, *Halicryptus spinulosus*, which is very abundant in the Baltic, also possesses denticles remarkably resembling Conodonts both in form and structure.

The authors conclude their paper as follows:—"As the result of our investigations, therefore, it appears that in their structure the Conodonts have nothing in common with the teeth, composed of dentine, of the Selachia or any other fishes, nor with the corneous teeth of the Cyclostomi, and that they cannot be interpreted as lingual denticles of Mollusca, hooks of Cephalopoda, or fractured points of Crustacea, but that they agree admirably both in form and structure with the buccal apparatus of Worms, and especially of Annelida and Gephyrea.

"Consequently not only those already recognized by Hinde as Annelid jaws, but all the Conodonts, are calcified cuticular buccal or œsophageal denticles of Worms, consisting of parallel lamellæ superimposed upon each other. From the great multiplicity of form we may conclude that the Conodonts are derived from numerous genera and species, and that consequently, in the Palæozoic era, the shores of the sea were peopled with a great abundance of Worms of very different kinds."—*Sitzungsb. der k. bayr. Akad. der Wiss., Math.-phys. Classe*, 1886, pp. 108–136, with 2 plates.

Note on the Reptiles and Batrachians collected by Captain Em. Storms in the Tanganyika Region. By M. L. Dollo.

In this paper M. Dollo enumerates the species of Reptiles and Batrachia collected by Capt. E. Storms in the neighbourhood of Lake Tanganyika, and describes two new forms. The Batrachia recorded are *Rappia marmorata*, Günth., and *Bufo regularis*, Reuss. The known species of Reptiles are *Agama atricollis*, Smith, *A. planiceps*, Peters, *Varanus niloticus*, Linn., *Euprepes varius*, Pet., *Chamæleon dilepis*, Leach, *C. gracilis*, Hallowell, *Typhlops Schlegelii*, Bianconi, *Boodon infernalis*, Günth., *Bucephalus capensis*, Smith, *Philothamnus Smithi*, Bocage, *Psammophis sibilans*, Jan, *Rhamphiophis rostratus*, Pet., *Atractaspis Bibronii*, Smith, *Causus rhombeatus*, Licht., and *Vipera arietans*, Schleg.

The new species are both snakes. The Colubrine *Grayia Giardi*, Dollo, is distinguished from *Grayia silurophaga*, Günth., by having the anterior temporal single instead of double, three instead of two

postoculars, both the fourth and fifth labials touching the eye, and nineteen instead of seventeen longitudinal rows of scales. Günther's species lives in West Africa, and received its specific name from the fact that the specimen described had two Siluroid fishes in its digestive tube; M. Dollo found in his the hind limbs of an Anurous Batrachian.

The second new form is referred to the Elapidæ, and constitutes a new genus allied to *Naja*, but distinguished from all known Elapidæ by the following characters:—

"A series of three or four simple teeth behind the poison-fangs. Rostral moderate. Two nasals, in contact with the preocular. Two postoculars. Neck not dilatable. Scales not arranged obliquely, smooth, in twenty-one longitudinal series. Anal single. Urostega double."

The genus is named *Boulengerina*, in honour of Mr. G. A. Boulenger, and the species *B. Stormsi*, after its discoverer.—*Bull. du Mus. Roy. d'Hist. Nat. de Belgique*, tome iv. pp. 151–157.

On Spongilla glomerata, *Noll.* By Dr. F. Vejdovský.

The author notes that the freshwater sponge lately described by Noll under the name of *Spongilla glomerata* (Zool. Anz. Nov. 1886, p. 682) is identical with *Spongilla fragilis*, Leidy, the synonymy of which species is as follows:—

Spongilla fragilis, Leidy (1851), Vejdovský (1884), Wierzejski (1885, 1886), F. Petr (1885, 1886), Potts (1885).
Spongilla Lordii, Bowerbank (1863), Wierzejski (1884).
Spongilla contecta, Noll (1870), Retzer (1883).
Spongilla sibirica, Dybowski (1878–84) *.

The author further remarks upon the presence of a layer of air-chambers in the envelopes of the gemmules of freshwater sponges, such as *S. fragilis*, *Trochospongilla erinaceus*, *Euspongilla lacustris*, *Ephydatia Mülleri*, &c., and gives the following list of the known European species of the group:—

Fam. Spongillidæ.

a. Subfam. Spongillinæ, *Cart.*

I. Genus Spongilla.

α. Subgen. *Euspongilla*, Vejd.

1. Euspongilla lacustris, *Aut.*
2. Euspongilla rhenana, *Retzer.*

β. Subgen. *Spongilla.*

3. Spongilla fragilis, *Leidy.*

b. Subfam. Meyeninæ, *Cart.*

II. Genus Trochospongilla, *Vejd.*†

4. Trochospongilla erinaceus, *Ehr.*

III. Genus Ephydatia, *Gray*, nec *Lam.*

5. Ephydatia Mülleri, *Lieb.*
6. Ephydatia fluviatilis, *Aut.*
7. Ephydatia bohemica, *Petr.*

IV. Genus Carterius, *Potts.*

8. Carterius Stephanowii, *Petr.*

Zoologischer Anzeiger, no. 239, Dec. 6, 1886, p. 713.

* The notion that *Spongilla sibirica*, Dyb., is identical with *S. fragilis*, Leidy, was first put forward by Mr. H. J. Carter.

† This genus is represented in the American fauna by *Trochospongilla Leidyi.*

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

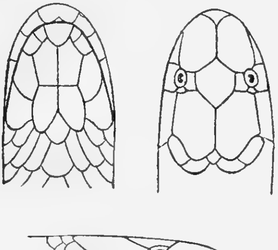
[FIFTH SERIES.]

No. 111. MARCH 1887.

XXI.—*Description of a new Snake, of the Genus* Calamaria, *from Borneo.* By G. A. Boulenger.

Calamaria Lovii.

Four upper labials, third entering the eye; first pair of lower labials widely separated by the mental; no azygos



Calamaria Lovii.

shield in contact with the anterior chin-shields. Rostral as deep as broad, only a very small portion visible from above; the suture between the præfrontals two thirds the length of the frontal; latter shield as broad as long, as

long as the suture between the parietals; no præocular. Body much elongate, of equal thickness throughout. Scales in thirteen rows. Ventral plates 211; subcaudals 22. Plumbeous; back with longitudinal lines of light dots; upper lip yellowish (in spirit); side of the anterior fourth of the body with a series of large yellowish spots; a few other such spots on the tail and a cross band of the same colour above the vent.

Total length 265 millim.; diameter of body 5.

A single specimen was obtained on the Rejang River, Sarawak, and presented to the Natural-History Museum by Brooke Low, Esq.

I seize this opportunity to observe that *Elaphis Grabowskyi*, Fischer, from S.E. Borneo, of which the type specimens are now in the Museum, is identical with *E. tæniurus*, Cope. The characters pointed out by Dr. Fischer as distinguishing his new species from *E. tæniurus*, with which he correctly compares it, are individual variations. I will merely remark that we have specimens from Pekin with nine or even ten upper labials. The range of this snake, originally described from Ningpo and Siam, is an exceptionally extensive one. In addition to the Bornean specimens just mentioned the species is represented in the Natural-History Museum from the following localities:—Chikiang (*Fortune*), Shanghai (*Swinhoe*), Pekin (*Bushell*), Darjeeling (*Jerdon*), and Pajo, Sumatra (*Bock*).

XXII.—*On a new Family of Pleurodiran Turtles.* By G. A. Boulenger.

A recent number of the 'Proceedings of the Linnean Society of New South Wales' (2nd ser. vol. i. 1886) contains the description, by Mr. E. P. Ramsay, of a new freshwater turtle from the Fly River, New Guinea, which is one of the most striking discoveries made in recent herpetology during the past twenty years. Unfortunately the author does not dwell sufficiently upon the systematic position of his new genus, to which the name *Carettochelys* is given; and his comparison with *Emyda* and his remark that it appears to be a link between the river- and the sea-turtles are merely based on

superficial resemblance. Although all I know of the animal is derived from Mr. Ramsay's description and figures, yet I think that a few words as to its systematic position will usefully supplement that interesting contribution.

We may first assume that *Carettochelys* is a Pleurodiran. To say nothing of its habitat (all Papuasian and Australian Chelonians belonging to that division), the tendency of the neural bones to disappear altogether and the numerous band-like plates on the fore limbs are highly suggestive of such affinity. By "head non-retractile" I understand the author to mean that the animal is a Pleurodiran; but not a word is said of the attachment of the pelvis, and the absence of epidermic scutes deprives us of the well-known criterion afforded by the azygos gular plate. Then we see that it differs from all recent Chelonians (save the Trionychidæ, from which it is well distinguished, besides being a Pleurodiran, by the structure of the plastron) by the absence of epidermic scutes on the shell. It differs also from all freshwater turtles by the structure of the limbs, which form regular paddles, as in the marine turtles, and which have likewise only the two inner digits clawed. This of course is mere adaptive similarity, and implies no affinity whatever with the Chelonidæ. Although *Carettochelys* stands alone among recent non-Trionychoid Chelonians in the absence of epidermic scutes, it agrees in this respect with the Tertiary Cryptodiran genera *Anostira*, Hallow., and *Pseudotrionyx*, Dollo *. And although the limbs of the latter are still unknown we may provisionally, taking the shell only into consideration, surmise that *Carettochelys* holds in the Pleurodiran series pretty nearly the place held by these extinct types in the Cryptodiran series. Whatever this hypothesis be worth, the new genus deserves to rank as the type of a new family of Pleurodira, which may be characterized as follows:—

Carettochelydidæ.

Limbs paddle-shaped, the anterior much elongate; only the first and second digits clawed. No epidermic scutes on

* It is intentionally that I abstain from mentioning *Apholidemys*, Pomel (Arch. Sc. Phys. et Nat. Genève, iv. 1847, p. 328), referred by Cope to the Emydidæ. Pomel characterizes it as a Chelonian with the carapace of an *Emys*, but devoid of scales, and the plastron of a *Trionyx*. The genus is afterwards referred by Gervais to *Trionyx*. As it stands at present, however, *Apholidemys* is hardly more than a *nomen nudum*.

the carapace and plastron. Plastron formed of the normal nine bones *, without persisting fontanelles.

XXIII.—*Descriptions of new South-American Characinoid Fishes.* By G. A. Boulenger.

Curimatus hypostoma.

D. 11 (I. 10). A. 9 (I. 8). V. 9. L. lat. 49–52. L. transv. $\frac{8}{8}$.

The height of the body equals or slightly exceeds the length of the head, and is contained four times in the total length (without caudal). Abdomen flattened in front of and behind the ventrals. Snout as long as the diameter of the eye, strongly projecting beyond the mouth, flattened inferiorly; the diameter of the eye is contained thrice and one third to thrice and two thirds in the length of the head; a much developed adipose eyelid in front and behind. Caudal fin deeply forked, a little longer than the head. The height of the dorsal is a little less than the length of the head; its origin is midway between the end of the snout and the adipose fin, corresponding to the tenth to twelfth scale of the lateral line. Extremity of pectorals separated from base of ventrals by a length of three or four scales; ventrals not reaching the vent. Scales with their entire margin conspicuously serrated. Uniform silvery, back darker and with bluish reflections; lower caudal rays darker.

Total length 120 millim.

Four specimens; from the Ucayali River, collected by Mr. W. Davis; presented by Messrs. Veitch.

Allied to *C. asper*, Gthr., and *C. trachystethus*, Cope; but the body is much less elevated in this species, which even surpasses *C. albula*, Gthr., in the strongly projecting snout.

Tetragonopterus Iheringii.

D. 2/8. A. 3/16–18. L. lat. 35–37. L. transv. $\frac{5-5\frac{1}{2}}{3-4}$.

Lateral line complete. The greatest depth of the body is contained twice and two thirds to thrice in the total length

* I think it may be taken for granted that there are no intersternals, and that the triangular shield represented on pl. iii. is merely part of the marginal, the plastron having been sawed off.

(without caudal), the length of the head four times to four times and one third. The diameter of the eye exceeds the length of the snout and equals the width of the interorbital space; no well-developed adipose eyelid. The maxillary extends beyond the anterior margin of the eye. The vertical from the origin of the dorsal fin falls behind the root of the ventrals, and the origin of the anal behind the last dorsal ray; the pectoral reaches the root of the ventrals, or not quite so far. A blackish spot behind the shoulder; a silvery lateral band, turning to black on the tail; dorsal, anal, and caudal fins finely speckled with black.

Total length 88 millim.

This species resembles much in coloration and proportions the young *T. rutilus*, Jen., from which it is easily distinguished by the number of dorsal and anal rays and the larger scales.

Fifteen specimens, from San Lorenzo, Rio Grande do Sul; collected by Dr. v. Ihering.

Tetragonopterus Luetkenii.

D. 2/9. A. 3/21–22. L. lat. 33–35. L. transv. 10–11.

Lateral line not continued to the tail, extending on from ten to sixteen scales. The greatest depth of the body is contained twice and one third to twice and a half in the total length (without caudal), the length of the head four times. The diameter of the eye exceeds the length of the snout and is less than the width of the interorbital space; no well-developed adipose eyelid. The maxillary extends to or somewhat beyond the anterior margin of the eye. The vertical from the origin of the dorsal fin falls behind the root of the ventrals, and the origin of the anal just below or slightly behind the last dorsal ray; the pectoral reaches the root of the ventrals. A round black spot behind the shoulder and another on the base of the caudal, the median rays of which are black; a silvery lateral band; dorsal and anal fins finely speckled with black.

Total length 85 millim.

Four adult and three young specimens from San Lorenzo, Rio Grande do Sul; collected by Dr. v. Ihering.

Three other species, from the province Rio Grande do Sul, were sent by Dr. v. Ihering. I refer them to *T. maculatus*, L. (=*microstoma*, Hensel, nec Günth.), *T. rutilus*, Jen., and

T. obscurus, Hens. The following synopsis is made from the specimens transmitted by the above-named gentleman :—

I. Lateral line continued to the tail.

A. Dorsal with nine branched rays.

Depth of the body not more than twice and a half in the total length (without caudal); 22 to 28 branched rays in the anal; scales $\begin{array}{c}7\\ \hline 34-37\\ \hline 6\end{array}$ .... *maculatus.*

Depth of the body more than twice and a half in the total length; diameter of the eye much greater than the length of the snout; 19 to 24 branched rays in the anal; scales $\begin{array}{c}7-8\\ \hline 36-39\\ \hline 5\end{array}$ .... *rutilus.*

Depth of the body thrice in the total length; diameter of the eye not exceeding the length of the snout; 19 branched rays in the anal; scales $\begin{array}{c}7\\ \hline 38\\ \hline 4\end{array}$ .... *obscurus.*

B. Dorsal with eight branched rays; anal with sixteen to eighteen.

Depth of the body more than twice and a half in the total length (without caudal); scales $\begin{array}{c}5-5\frac{1}{2}\\ \hline 35-37\\ \hline 3-4\end{array}$ .... *Iheringii.*

II. Lateral line not continued to the tail.

Dorsal with nine branched rays; anal with twenty-one or twenty-two; depth of the body not more than twice and a half in the total length (without caudal); scales $\begin{array}{c}5\\ \hline 33-35\\ \hline 4\end{array}$ .... *Luetkenii.*

XXIV.—*Notes on some Species of Inland Mollusca.* By T. D. A. Cockerell.

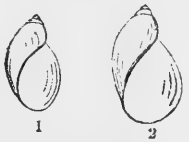
Arion ater, L.

The distribution of the colour-varieties of this species is peculiar: a bright brick-red form (var. *rubra*, Moq.-Tand. 1855) appears to be prevalent in Belgium, though, so far as is at present known, it does not occur in Britain. My brother found it commonly at Brussels, and last year the Hon. Miss M. C. E. Leigh sent me specimens from Spa, together with the variety *Draparnaldi*, Moq., and *Arion subfuscus*, Drap. It is generally supposed that the red forms of *Arion* are developed in dry situations, while the darker or black varieties inhabit damp and marshy spots; and this seems to have been

the case with the Belgian var. *rubra*, as Miss Leigh writes :—"I observed three red slugs, two in one path and one in another, in a wood outside and some way above the town. The paths were a short distance from a stream, but themselves very dry, full of stones and slate, surrounded by grass, heather, and bushes." My brother (S. C. C.) has also taken the brick-red variety at Rouen.

Succinea vitrea, Jeffr.

This species was first described as *S. putris*, var. *vitrea* *, by Gwyn Jeffreys, who subsequently identified it with Morelet's *S. virescens* †, and it has since been known under the latter name to British conchologists. As a species I think it is at least as distinct as most others of the genus ; but it seems extremely doubtful whether our form is Morelet's *S. virescens*, since the figure of that species given by Kobelt (Rossm. Icon. fig. 2088) belongs evidently to a variety or subspecies of *S. Pfeifferi*. Baudon's *S. debilis* closely resembles our species in shape, but it is much smaller, and appears also to belong to the *Pfeifferi*-section of the genus. It therefore becomes necessary, since neither Morelet's *virescens* nor Baudon's *debilis* belong even to the same section of the genus, to adopt for our species Jeffreys's name *vitrea* ‡, the characters being a short and blunt spire, shallow suture, large aperture, and the ex-



Succinea vitrea, Jeffreys.
1. Wressle, Yorks. 2. Var. *aurea* : Clonmel.

tremely fragile and thin texture of the shell. The typical form of the species is pale greenish and transparent, sometimes inclining to pale brown ; but a variety which I call *aurea* occurs near Clonmel in Ireland, and is of a beautiful translucent amber colour.

* 'British Conchology,' vol. i. p. 152.

† Ann. & Mag. Nat. Hist. Nov. 1878.

‡ *S. vitrea* has been recorded from the following counties in Britain :—Kent, Surrey, Middlesex, Warwick, Herts, Hants, Worcester, Sussex, Carmarthen, Tipperary, and Cork ; and I have recently received it from Yorkshire, which is the most northern locality at present known.

Succinea Pfeifferi, Rossm. (*S. ovalis*, Gould).

This has been very generally known as *S. elegans* in England, but the true *S. elegans*, Risso, is comparatively scarce in this country.

Gould's *Succinea ovalis*, which is very common on the North-American continent, is undoubtedly identical with this species, and indeed it would seem that *S. Pfeifferi* or *ovalis* had its origin, together with such species as *Helix pulchella* and *Cochlicopa lubrica*, in the boreal regions of Europe and America, at a time when the two continents were still united. *S. elegans*, on the other hand, seems to have its greatest development in central and southern Europe, producing such forms as *S. Dunkeri*, Zeleb., *S. hungarica*, Hazay, and *S. megalonyxia*, Bourg. In an interesting collection of shells from St. Thomas, Ontario, Canada, sent to me by my brother (Mr. D. B. Cockerell), there are specimens of *S. ovalis*, which are scarcely to be distinguished from Baudon's var. *ventricosa* of *S. Pfeifferi*, and from the same locality such well-known European forms as *Conulus fulvus*, Drap., *Helix pulchella*, Müll. (type form), *Cochlicopa lubrica*, Müll., *Limnæa truncatula*, Müll. (of the American form *humilis*, Say, and an elongated variety resembling *rustica*, Lea), *Planorbis parvus*, Say (=*glaber*, Jeffreys), and *Pisidium pusillum*, Gmel. (=*abditum*, Hald.), as well as an abundance of American species, some very closely allied to European forms, and others peculiarly American, the list including:—*Hyalina indentata*, Say; *H. electrina*, Gould; *H. arborea*, Say; *H. minuscula*, Binney; *Helicodiscus lineatus*, Say; *Conulus chersinus*, Say (var.); *Helix alternata*, Say; *H. perspectiva*, Say (var.); *H. striatella*, Anth.; *H. monodon*, Rack, and a distinct variety; *H. albolabris*, Say; *Pupa contracta*, Say; *P. rupicola*, Say; *P. fallax*, Say; *Planorbis armigerus*, Say; *Pomatiopsis lapidaria*, Say; *Pisidium variabile*, Prime; *Sphærium striatinum*, Lam.; *S. tumidum*, Prime; and *S. sulcatum*, Lam.

Succinea ovalis, Gould.
St. Thomas, Ontario.

5 Priory Road, Bedford Park,
Chiswick, Feb. 6, 1887.

XXV.—*Notes on the Palæozoic Bivalved Entomostraca.—No. XXIII. On some Silurian Genera and Species* * *(continued)*. By Prof. T. Rupert Jones, F.R.S., F.G.S.

[Plates IV., V., VI., VII.†]

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Introduction.

At pp. 343, 344, Ann. & Mag. Nat. Hist. for April 1886, is a full account of the history of the valuable collections of Silurian Ostracoda which have been described in part by the late Dr. Harvey B. Holl and myself. Some of the *Beyrichiæ* and their allies were treated of and figured in the same number of the Ann. & Mag. Nat. Hist., and others in the number for last May, pp. 403–414, with further illustrations. I have now to continue the work without the aid of our lamented friend, except so far as many valuable drawings prepared by him, some indeed within a

* For No. XXII. see Ann. & Mag. Nat. Hist. for October 1886, p. 249.
† These Plates have been drawn with the aid of a grant from the Royal Society for the illustration of Fossil Entomostraca. Mr. C. D. Sherborn has kindly given me help in cataloguing, comparing, sketching, and measuring the species.

few months of his death*, are at hand for reference and comparison. Not a few of these have been incorporated in the accompanying Plates.

The Ostracoda that still remain in the above-mentioned Collections to be described are chiefly those appertaining to *Macrocypris*, *Pontocypris*, *Bythocypris*, *Cythere*, *Cytherella*, *Thlipsura*, *Æchmina*, *Primitia*, &c.; and in estimating the leading characteristics of the carapace, the relative size of the two valves, the shape of each extremity, and other features of the carapace, Dr. Holl's comparative drawings, often several for one object, are vivid expressions of his views on the subject, and frequently of much service in determining the genus and species.

I. Macrocypris, G. S. Brady, 1867.

Cythere, *Bairdia*, &c., auctorum.

1867. *Macrocypris*, G. S. Brady, Intellectual Observer, vol. xii. p. 119; "Monogr. Recent Brit. Ostrac.," Trans. Linn. Soc. vol. xxvi. 1868, p. 391; Report Ostrac. 'Challenger' Exped. 1880, p. 40.

Carapace subcylindrical or long triangular, and often *Bairdia*-like, generally elongate, attenuated at the extremities; valves thin, smooth, unequal, with bevelled plates within the ends, more or less sinuate on the ventral margin, the right larger than the left and overlapping dorsally; hinge-line flexuous.

This genus is a member of the section of the Ostracoda known as Podocopa, and belongs to the family Cyprididæ, which comprises marine as well as freshwater species.

Some specimens obtained from the Silurian shales appear to belong to this genus, and represent certainly three undescribed species. Formerly such specimens were referred to *Cythere* a name used to cover the generic alliance of those small Ostracoda which could not be exactly or satisfactorily determined. Now, however, that not only *Cythere* but its allied genera have been fully elucidated in the living state, it is found that the genus does not comprehend many of the fossil forms once referred to it †. Whether these really

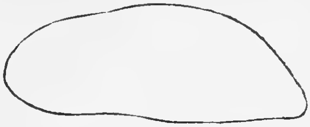
* In September last. See Geol. Mag. for Nov. 1886, p. 527.

† Dr. G. S. Brady's researches on the Recent Ostracoda have given us much clearer views than we had heretofore of the relationship of these Bivalved Entomostraca, and have enabled us to refer several of the fossil forms to their probable genera as represented among their modern and existing allies. See, for instance, the paper on "Some Carboniferous Ostracoda," Ann. & Mag. Nat. Hist. for October 1886. Among Dr. Brady's many valuable memoirs and monographs we note more especially his "Monograph of the Recent British Ostracoda," Trans. Linn.

belong to the Cytheridæ or to the Cyprididæ it is often difficult to say; but the genus *Cythere* comprises very few of the smooth subovate forms, and none that have toothless hinges. Hence we find that a real *Cythere* is scarcely known in Palæozoic strata; and when the term is applied to such old forms it is in a very general and probably artificial sense.

1. *Macrocypris Vinei*, sp. nov.
(Pl. IV. figs. 1, 2, 3; and woodcut.)

1882. "*Bairdia elongata*, Münster (?)," Vine, Quart. Journ. Geol. Soc. vol. xxxviii. p. 48.



Macrocypris Vinei, sp. nov. Thick variety (♀ ?). Magn. 25 diam. Vine Coll. LXV_7. Bed no. 46.

Proportions*:		Length.	Height.	Thickness.
	Fig. 3:	41	14	13
	Woodcut:	40½	13	
	Fig. 1:	39	13	10
	Fig. 2:	33	10	9½

Measurements of some specimens in 1000ths of an inch:—

Length.	Height.	Thickness.		
80	29	25	Vine Coll.	Bed no. 40.
80	23	20	Vine Coll.	Bed no. 46.
75	27	22	Vine Coll.	Bed no. 46.
65	24	18	Smith Coll.	Railway, Ironbridge.

Carapace smooth, nearly equivalved, elongate, subcylindrical, tapering at each end; rounded and compressed in front, obliquely acute at the postero-ventral extremity; arched above, nearly straight below. In some cases the dorsal edges fall in a little, so that the middle of the back is slightly flattened. The ventral edge of the left valve slightly overlaps its fellow, and sometimes an overlap by the right valve on the dorsal edge is discernible, but not so strong as in most of the recent species. Some indications of a rose-shaped muscle-spot are visible.

Soc. xxvi. 1868; the "Monograph of the Post-Tertiary Entomostraca," &c., by Brady, Crosskey, and Robertson, Palæont. Soc., 1874; and Dr. Brady's "Report on the Ostracoda of the 'Challenger' Expedition," 1880.

* If these proportional numbers be divided by 25, the results will be the real measurements in millimetres and parts of a millimetre.

Excepting that its dorsal border is much less arched, this species resembles in many respects *M. orientalis*, Brady, "Ostracoda of the 'Challenger,'" p. 42, pl. i. fig. 4.

The several specimens differ in detail. Fig. 3 shows the best example. Some are shorter and higher on the back towards the posterior third than others (woodcut, Vine Coll. LXV_7). Possibly the narrow individuals were males. The relative convexity also of the lateral contour differs, being more median in some (as in fig. 3 *b*) than in others. The hinder extremity often varies in outline, probably on account of different states of preservation (figs. 1 and 2 are such casts).

This fine species is named after Mr. G. R. Vine, of Sheffield, who so generously gave me the valuable collection, on accumulating and arranging which he had bestowed much labour.

Mr. Vine states that the finest specimens of this species were obtained from the "shales over the Wenlock Limestone."

Eleven specimens:	Vine Coll. no. I.	Bed no. 46. Shales over Wenlock Limestone, figs. 1 and 2.
	II.	Bed no. 40. Buildwas Beds.
	LXIV_7.	Buildwas Beds. Small.
	LXV_7.	Shales over Wenlock Limestone. Woodcut.
	LXVII.	Bed no. 46. Shales over Wenlock Limestone.
Five specimens:	Smith Coll. 65.	Railway-cutting, side of Severn, Ironbridge, fig. 3.

2. *Macrocypris elegans*, sp. nov.
(Pl. V. figs. 8 *a*, 8 *b*, 8 *c*.)

Proportions :—L. 22. H. 10. Th. 10.

An elegant, subreniform, smooth, convex carapace, higher and more boldly rounded behind than in front, as seen in the profile, fig. 8 *a*, but equally compressed at the ends, as shown by the acute-oval contour, fig. 8 *b*. The right valve is larger than the left, overlapping all round. The back is elliptically arched, the ventral margin is sinuous, and the ends unequally rounded; end view nearly round.

The *Bythocypris? pyrula*, J. & K., of the Mountain-limestone (Ann. & Mag. Nat. Hist. October 1886, p. 252, pl. vi. figs. 10 and 11) is not unlike this species in general appearance.

Vine Coll. (one specimen) no. III. Bed no. 40. Buildwas Beds.

3. *Macrocypris siliquoides*, sp. nov.
(Pl. V. figs. 9 *a*, 9 *b*, 9 *c*.)

Proportions :—L. 22. H. 8. Th. $6\frac{1}{2}$.

Probably a *Macrocypris*, the right valve being somewhat larger than the left. Carapace small, long, and narrow, or elongate-amygdaloid; nearly cylindrical, but tapering at the ends, and somewhat compressed anteriorly. More arched on the back than below, where the margin is slightly sinuous and incurved.

Two specimens. Vine Coll. no. IV_2. Bed no. 46. Shales over the Wenlock Limestone; and no. 22. Buildwas Beds.

4. *Macrocypris symmetrica*, sp. nov.
(Pl. VII. figs. 8 *a*, 8 *b*.)

Proportions :—L. $15\frac{1}{2}$. H. 7. Th. 5.

Measurement in 1000ths of an inch :—

L. 30. H. 16. Th. 12.

Carapace small, smooth, subcylindrical, narrow, almond-shaped in profile; feebly arched above, slightly curved below, rounded at the ends, one of them (anterior) more compressed than the other. Right valve overlapping the left. Edge view narrow, acute-ovate.

This is smaller and proportionately shorter and thicker than *M. siliquoides*.

Smith Coll. (one specimen) no. 63_1. Woolhope.

5. *Macrocypris? alta*, sp. nov.
(Pl. V. figs. 10 *a*, 10 *b*.)

Proportions :—L. 13. H. $8\frac{1}{2}$. Th. 6.

Carapace small, convex, short, subovate, rounded above and at the ends, nearly straight below. Compressed in front, so that the lateral contour is ovate with one acute end. The right valve is apparently the largest.

Smith Coll. (one specimen) no. 53_3. Railway-cutting, side of Severn, Ironbridge.

5. *Macrocypris? crassula*, sp. nov.
(Pl. VII. figs. 10 *a*, 10 *b*.)

Proportions :—L. 19. H. 10. Th. 8.

Taking the narrowest (lowest) end for the anterior, the right valve of this carapace strongly overlaps the other. This

character is found in *Cytherella* and *Macrocypris*. The shape of this carapace does not correspond at all with that of *Cytherella*, nor closely with that of any known *Macrocypris*; but rather than make it the basis for a new genus, I have provisionally grouped this specimen with *Macrocypris*, which has the right valve larger than the left, though not so markedly overlapping all round as in this instance.

The carapace is of a narrow-subovate form with very thick valves, the right strongly overlapping the left all round. It has a considerable median convexity. Edge view compressed-oval with subacute ends; end view nearly round. At first sight this little carapace looks like a dwarf *Bythocypris Phillipsiana*, but the overlapping valve is the right instead of the left.

Unique: collected by Dr. H. B. Holl in the Wenlock Limestone, Crofts, near Malvern.

II. Pontocypris, G. O. Sars, 1865.

Pontocypris, G. S. Brady, Report Ostracoda 'Challenger' Expedition, 1880, p. 35.

Several specimens in Mr. Vine's Collection have a somewhat *Bairdia*-like carapace, but having one valve overlapping the other on the dorsal border, and overlapped on its own ventral edge. This condition of the valves separates the form under notice from *Bairdia*. Its peculiar subtriangular shape presents a close analogy to that of *Pontocypris*; and as the recent forms, though with less overlap, do not gainsay a near relationship, I provisionally refer it to this genus.

1. *Pontocypris Mawii*, sp. nov.
(Pl. IV. figs. 4*a*–4*d*, & fig. 7; fig. 6, var. *gibbera*, ♀?.)

		Length.	Height.	Thickness.
Proportions:	Fig. 4:	36	18	12
	Fig. 7:	32	16	
	Fig. 6: (var.)	29	18	11

Measurement in 1000ths of an inch:—

Fig. 4: L. 68. H. 35. Th. 33.

Carapace convex, triangular-ovate or subpyriform; arched above, nearly straight below; sharp, compressed, and tapering at the ends; posteriorly more attenuate, and with a longer slope than in front, where it is almost truncate, curving with a sudden slope downwards, and less compressed than behind. Thus the antero-dorsal slope is steeper and more convex than the hinder slope, which is longer and flatter, and makes the postero-ventral angle more produced than the front. The

thicker and higher end being the anterior is proved in recent specimens by the position of internal organs. The valves are smooth and subtriangular; the left overlaps the other on the dorsal border, and the right valve overlaps on the ventral border. The lateral contour (seen in the edge view) is subovate, with rather flattened sides and subacute ends; but these features differ with individuals. The shape differs from long- to short-pyriform (figs. 4 and 6). Thus, still keeping their differences within bounds, the valves are much longer in figs. 4 and 7 than in fig. 6 (var. *gibbera*). The differences between the short and hump-backed variety (fig. 6) and the long pear-shaped form (figs. 4 and 7) are striking, but not sufficient to make them specifically distinct. They may be sexual differences: the valves were probably thin in substance.

G. S. Brady's figure of *Pontocypris faba* (Reuss), "Report Ostrac. 'Challenger,'" pl. i. fig. 4, comes near to our Silurian form; but this latter seems to be distinct from any, and requires a name. I propose to name it *P. Mawii*, dedicating it to Mr. George Maw, F.G.S., who so thoughtfully had some tons of the Silurian shales near Benthall, in Shropshire, thoroughly washed and sifted, and instigated his palæontological friends to submit the sorted contents to scientific examination.

There is much resemblance between the Lower-Silurian *Cythere Jukesiana*, J. & H., Ann. & Mag. Nat. Hist. ser. 4, vol. ii. p. 57, pl. vii. fig. 6 (misprinted "fig. 7," *ibid.* p. 62), and some of the specimens before us. The former, however, has a more tapering posterior moiety (regarded as "anterior," *loc. cit.*), and less of the dorsal convexity. It is advisable to refer the above-mentioned Kildare specimen to *Pontocypris*.

Twenty-seven specimens:
- Vine Coll. no. V. (fig. 6). Bed no. 22. Buildwas Beds.
- VI. Bed no. 25. Tickwood Beds.
- VII. (figs. 4 and 7). Bed no. 22. Buildwas Beds.
- IX. Bed no. 25. Tickwood Beds.
- LXIV$_{16, 17, 18}$. Buildwas Beds.

Ten specimens:—Smith Coll. no. 56. Railway-cutting, side of Severn, Ironbridge.

2. *Pontocypris Smithii*, sp. nov.
(Pl. IV. figs. 5 *a*–5 *d*.)

Proportions:—L. 36. H. 20. Th. 16.

Measurements in 1000ths of an inch:—

Length.	Height.	Thickness.
74	40	30
74	38	30

Carapace convex, smooth, subreniform, with rounded ends, equally compressed. The anterior half sloping down quickly and the hinder half slowly from above downwards. Back elliptically convex; ventral margin rather incurved. Left valve subpyriform, overlapping on the back, and the right valve nearly kidney-shaped, overlapping ventrally.

Smith Coll. (four specimens) no. 64. Wenlock Beds, Dudley Castle. Also found in the Woolhope Shale, at the Wych, Malvern, by the late Dr. Holl.

Dedicated to Mr. John Smith, of Kilwinning, Ayrshire, who kindly confided his Collection to me for examination, and who has thus largely added to the store of available specimens of Ostracoda from the Silurian shales of Shropshire.

III. Bythocypris, Brady, 1880.

Carapace smooth, more or less reniform; "left valve much larger than the right, which it overlaps both on the dorsal and ventral margins" ("Report Ostracoda of the 'Challenger,'" p. 45).

1. *Bythocypris Hollii*, sp. nov.
(Pl. V. figs. 1 *a*, 1 *b*, 2; Pl. VI. figs. 3 *a*, 3 *b*, 4 *a*, 4 *b*.)

Proportions:	Length.	Height.	Thickness.
Pl. V. fig. 1:	35	19	15½
Pl. VI. fig. 3:	34	21	17
Pl. V. fig. 2:	34½	22½	
Pl. VI. fig. 4 (crushed)	33	16	15

Carapace convex, smooth, reniform, nearly semicircular on the back, gently sinuous below. Edge view acute-oval; end view ovate. Left valve overlapping the right along the ventral border and nearly all round. In these features it connects itself with *Bythocypris*. Pl. VI. fig. 3, probably the female, is higher and more ovate than Pl. V. fig. 1, being more convex in the posterior third and less incurved on the ventral border. Pl. V. fig. 2 is much higher and proportionally shorter than either fig. 1 or Pl. VI. fig. 3, with a straight ventral and a highly arched dorsal line; and one end (poste-

rior) is much less rounded, being more truncate, with a steeper slope, than the other. It is possibly an *old female* or an obese variety. Pl. VI. fig. 4, is a somewhat crushed individual.

This fine species is dedicated to the memory of my late friend and fellow-worker, Dr. H. B. Holl, several of whose careful drawings aid me in the present work.

Dr. Holl pointed out to me not long ago that this species has nearly the shape of "*Cytherellina siliqua*, var. *grandis*," J. & H. (Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 217, pl. xiv. fig. 1), but the lateral contour (edge view) is distinctly different, as well as the end view. No doubt, however, exists that this var. *grandis* should now be regarded as *Bythocypris grandis*, J. & H. So also *C. siliqua* *, var. *ovata*, not far removed from the present Pl. V. fig. 2, and Pl. VI. fig. 3, may be looked upon as the female of *B. grandis*.

Vine Coll. (five specimens) LXVI$_{2, 3}$. Tickwood Beds.
Smith Coll. (five specimens) no. 50. Dudley Tunnel.

2. *Bythocypris? reniformis*, sp. nov.
(Pl. VI. figs. 1 *a*, 1 *b*, 2 *a*, 2 *b*.)

Proportions:		Length.	Height.	Thickness.
	Fig 1:	33	15	13
	Fig. 2:	25	12	10

Probably a *Bythocypris*, kidney-shaped, convex, and much more compressed at one end (anterior) than the other, as seen in the edge views, figs. 1 *b* and 2 *b*. Fig. 1 *a* differs from fig. 2 *a* in being larger and not so high proportionally in front.

This species is narrower than *B. Hollii*, and has its greatest convexity at the posterior third instead of in the middle.

Vine Coll. (two specimens) no. LXVI$_3$. Tickwood Beds.

3. *Bythocypris? botelloides*, sp. nov.
(Pl. VII. figs. 2 *a*, 2 *b*.)

Proportions:—L. 31. H. 14. Th. 14.

Nearly oblong, convex, subcylindrical, like a sausage; upper and lower edges parallel; the ends rounded almost equally. Edge view long-oval. End view round.

Smith Coll. (three specimens) no. 81$_{1, 3}$. Benthall Edge, Ironbridge.

* Keeping for *Cytherellina siliqua* fig. 5 and those specimens that actually show the internal sulcate structure.

4. *Bythocypris testacella*, sp. nov.
(Pl. V. figs. 5 *a*, 5 *b*, 5 *c*.)

Proportions:—L. 27. H. 12. Th. 10.

One specimen from Malvern: L. 60, H. 25-1000ths inch.

Long and narrow, but arched on the back; rounded at the ends and depressed along an antero-dorsal slope. Left valve largest, overlapping on the back. It has somewhat the appearance of a *Testacella* or of a hump-backed leech. Edge view long, narrow-oval. End view short-ovate.

Vine Coll. (four) no. LXVI$_3$. Tickwood Beds.

Smith Coll. (two) no. 81. Benthall Edge, Ironbridge.

Also found by the late Dr. Holl in the Wenlock Shale of Malvern.

5. *Bythocypris symmetrica*, sp. nov. (Pl. VII. figs. 3 *a*, 3 *b* (var. *c*), 4 *a*, 4 *b* (var. *b*), 7 *a*, 7 *b* (var. *a*).)

		Length.	Height.	Thickness.
Proportions:	Fig. 7 (var. *a*):	23	12	10
	Fig. 4 (var. *b*):	18½	9½	7½
	Fig. 3 (var. *c*):	17	8	6

A series of smooth oblong-ovate carapaces, varying in size and somewhat in profile, from figs. 7 *a* to 4 *a* and 3 *a*. The uniformly narrow subovate edge views of these varieties constitute an important link in their relationship.

Nine specimens:	Vine Coll. no. IV$_3$.	Bed no. 46.	
	XII.	Bed no. 38.	
	XV. (fig. 3).	Bed. no. ?	
Thirteen specimens:	Smith Coll. no. 62 (figs. 4 and 7).	Railway-cutting, side of Severn, Ironbridge.	
	79.	Red Shale, Malvern Tunnel (west end).	
	81.	Benthall Edge, Ironbridge.	

6. *Bythocypris concinna*, sp. nov. (Pl. V. figs. 6 *a*, 6 *b*, 6 *c*, and fig. 7 (var. *ovalis*).)

		Length.	Height.	Thickness.
Proportions:	Fig. 6:	23	11	9½
	Fig. 7:	19	9	

Measurements in 1000ths of an inch :—

	Length.	Height.	Thickness.
Large individual (fig. 6 *a*).	46	20	18
Var. *ovalis* (fig. 7). . . .	42	20	20

Carapace small, smooth, convex, acute-ovate ; not quite so much arched on the ventral as on the dorsal margin ; highest near the middle, but sloping off more gently to the anterior end, which is sharper and slightly more compressed than the posterior. The left valve (taking the most compressed moiety of the valves as the anterior) is larger than the other and overlaps it all round.

A more decidedly oval form (that is, with equal ends) is shown by fig. 7 (var. *ovalis*).

B. concinna has some features in common with *B. cuneola* of the Carboniferous formation, but is quite distinct in other respects (Ann. & Mag. Nat. Hist. Oct. 1886, p. 250, pl. vi. figs. 3–7).

Some rather obscure, subcylindrical, long-oval, internal *casts* of small valves, much like those of the above-mentioned form, were described in the Ann. & Mag. Nat. Hist. ser. 4, vol. iii. 1869, p. 212, woodcut fig. 1, as *Cythere Grindrodiana* ; but the latter are too small to be matched exactly. These little casts were from the Woolhope Shales of West Malvern.

Nine specimens : { Smith Coll. no. 61 (fig. 6). Stoke-Saye, near the Craven Arms.
62 (fig. 7). Railway-cutting, side of Severn, Ironbridge.

Also from the Aymestry Limestone, Chance's Pitch, Ledbury (*Dr. Holl*).

7. *Bythocypris Phillipsiana* (Jones & Holl).
(Pl. V. figs. 3 *a*, 3 *b*, var. *major* ; figs. 4 *a*, 4 *b*, 4 *c*, *typica*.)

1869. *Bairdia Phillipsiana*, J. & H., Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 213, pl. xiv. fig. 7.

		Length.	Height.	Thickness.
Proportions:	Fig. 3 :	27	$16\frac{1}{2}$	14
	Fig. 4 :	$22\frac{1}{2}$	14	8

Measurements in 1000ths of an inch :—

Fig. 3	Left valve	56	33	
	Right valve	53	27	
Fig. 4	Left valve	48	27	
	Right valve	45	22	
	Thickness of carapace . . .			17

This subtriangular or subreniform carapace has been already sufficiently described in the Ann. & Mag. Nat. Hist. for March 1869, from the Wenlock Limestone, near Malvern. The present specimens, however, of the typical form (Pl. V. fig. 4) have rather thinner valves and therefore more delicate outlines in profile and contour. We recognized it also in a Scandinavian Limestone (*loc. cit.*).

Pl. V. fig. 3 shows a larger and more ovate carapace, with proportionally thinner valves (var. *major*).

The Carboniferous variety of this species (var. *carbonica*, J. & K., Ann. & Mag. Nat. Hist. ser. 5, vol. xviii. p. 250, pl. vi. fig. 1) is very much like this predecessor, with but slight modification of its features.

Vine Coll. (two specimens). Fig. 3. No. VIII. Beds no. 25 and 25*, Tickwood Beds.

Smith Coll. (three). Fig. 4. No. 56. Railway-cutting, side of Severn, Ironbridge.

8. *Bythocypris pustulosa*, sp. nov. (Pl. VII. figs. 13 *a*, 13 *b*.)

	Length.	Height.	Thickness.
Proportions :—	20	11	13

Measurements in 1000ths of an inch :—

Left valve	35	18	
Right valve	31	15	
Thickness of carapace			17

Carapace strong, convex, ovate-oblong, arched above, straight below; hinder end rounded; front depressed, contracted, and sloping, with an oblique curve. Left valve overlapping all round. Lateral contour (edge view) acute-ovate. Surface pimpled with (red) raised spots.

Smith Coll. (one) no. 40. Stoke-Saye, near Craven Arms.
(three) no. 60. Railway-cutting, side of Severn, Ironbridge.

9. *Bythocypris? seminulum*, sp. nov. (Pl. VI. figs. 9 *a*, 9 *b*.)

Proportions :—L. $9\frac{1}{2}$. H. 5. Th. $4\frac{1}{2}$.

Carapace small, convex, subreniform, arched above, nearly straight below; ends nearly equal, but one rather more fully curved than the other. Lateral convexity central and symmetrical (fig. 9 *b*), making an acute-oval outline.

Smith Coll. (one) no. 53_1. Railway-cutting, side of Severn, Ironbridge.

10. *Bythocypris acina*, sp. nov.
(Pl. VI. figs. 10 *a*, 10 *b*.)

Proportions:—L. 11. H. 7. Th. 5.

Carapace small, nearly ovate, but less convex below than above, and contracted at one end like a grape-stone. Posterior moiety highly arched on the dorsal and postero-dorsal border. The front contracted, so as to project like the small end of a pear. Left valve larger than the other. Edge view oval, with sharp ends.

Smith Coll. (two specimens) no. 52. Railway-cutting, side of Severn, Ironbridge.

11. *Bythocypris phaseolus*, sp. nov.
(Pl. VII. figs. 11 *a*, 11 *b*, 12 *a*, 12 *b*.)

		Length.	Height.	Thickness.
Proportions:	Fig. 12:	$17\frac{1}{2}$	10	$5\frac{1}{2}$
	Fig. 11:	17	$9\frac{1}{2}$	$7\frac{1}{2}$

Fig. 12 *a* is a short, high, somewhat oblong carapace, arched above, almost straight below, flattish on the sides, and well curved at the nearly equal ends; resembling a kidney-bean. The edge view (fig. 12 *b*) is of a narrow, compressed, subovate outline, with one end much more acute than the other. Fig. 11 *a* is more kidney-shaped than fig. 12 *a*, and 11 *b* is fuller (thicker) than 12 *b*; this may be a sexual if not a varietal feature.

Vine Coll. (six specimens) no. XII. Beds no. 22 and no. 38. Buildwas Beds.

IV. Cythere, Müller, 1785.

Valves unequal (left valve rather larger than the right), oblong-ovate, subreniform, or quadrate. Surface either smooth or variously ornamented. Hinge-line distinct, toothed more or less strongly at its ends.

Excepting in this last particular there are some Silurian Ostracoda which would range among such *Cytheræ* as may have smooth subreniform carapaces, like *Cythere? laganella*, Brady ('Challenger' Ostrac. p. 63, pl. xvi. fig. 7). As the place of the hinge-joints is distinctly shown in some of the specimens before me, it may be allowed that those which have a generally similar aspect and straight hinge-lines should be provisionally placed in this subgroup of the genus; and thus the introduction of a new generic name is avoided. In this category we find:—Pl. VI. figs. 5 and 6, as large forms,

with some variation in shape; Pl. VII. figs. 1 and 5, much alike in outline, but differing in lateral contour; figs. 6 and 14, nearly agreeing in outline and differing very little in contour.

1. *Cythere Hollii*, sp. nov. (Pl. VI. figs. 5 *a*, 5 *b*, 5 *c* (var. *a*), figs. 6 *a*, 6 *b*, 6 *c* (var. *b*).)

		Length.	Height.	Thickness.
Proportions:	Fig. 5 :	$46\frac{1}{2}$	23	18
	Fig. 6 :	40	23	19

Measurements in 1000ths of an inch :—

	Length.	Height.	Thickness.
Fig. 6 :	66	36	30

Var. *a*. Large, convex, smooth, ovate-oblong, relatively long, thick and high in the posterior moiety and well-rounded behind; sloping up in the antero-ventral region to the narrower but neatly rounded front. Back straight along hinge-line. Edge view acute and narrow-ovate. End view somewhat obovate, almost round.

This is near *Cythere superba*, Jones and Kirkby, from the Lower Carboniferous strata of Scotland (Ann. & Mag. Nat. Hist. for October 1886, p. 266, pl. ix. fig. 11); but it is longer and narrower.

Two specimens, Smith Coll. no. 81_2. Benthall Edge, Ironbridge.

Var. *b* (figs. 6, *a*, *b*, *c*). This is also suboblong and otherwise like var. *a*; but it is relatively shorter, thicker, and higher behind, and less contracted in front. The anterior extremity is symmetrically rounded. The left valve is larger than the right (as in fig. 5), and overlaps to a small extent on the ventral border. Edge view ovate, somewhat compressed.

This is still nearer to *C. superba* in shape than var. *a*; but still it is not identical with it.

It was collected by the late Dr. H. B. Holl, from the Woolhope Limestone of the Malvern Tunnel; and to him the species is here dedicated, with cordial appreciation of his high worth as a geologist and palæontologist.

It is quite possible that these varieties, *a* and *b*, could each claim specific standing; on the other hand, it might be that *C. superba* should be a *variety* with them. For convenience, however, and according to what we know of Palæozoic Cytheridæ, I think it will be best to hold them in the arrangement indicated above.

(Four specimens.) Fig. 6. Collected by Dr. Holl in the Woolhope Limestone, Malvern Tunnel.

Fig. 5. Smith Coll. (one) no. 81_2. Benthall Edge, Ironbridge.

Smith Coll. (one) no. 8. Near Much-Wenlock.

2. *Cythere? Vinei*, sp. nov.
(Pl. VII. figs. 1 *a*, 1 *b*, 5 *a*, 5 *b*.)

		Length.	Height.	Thickness.
Proportions:	Fig. 5 :	20	11	$9\frac{1}{2}$
	Fig. 1 :	18	9	6

Measurements in 1000ths of an inch:—

Fig. 5 . . .	35	18	17
Another (XIII_2)	33	18	15

Neat, small, ovate-oblong carapaces, with straight back and gentle ventral convexity, especially at the hinder third. Ends rounded, unequal. Edge view more or less compressed-ovate. Fig. 5 *b* has much blunter ends to its contour than fig. 1 *b*; but the latter has been somewhat crushed. This species has a form near to that of *Cytherellina* (*Bythocypris?*) *tersa* (Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 217, pl. xiv. fig. 3), but the latter has an arched back.

Mr. Vine's name is connected with this species in recognition of his enthusiastic labour in obtaining the many Ostracoda from the Benthall washings (see vol. xvii. p. 343).

Four specimens:	Vine Coll. no. XIII_2 (var.?)	Bed no. 38.
	XIII_3 (fig. 5)	Buildwas Beds.
	LXVI_2 (fig. 1).	Tickwood Beds.
Two specimens:	Smith Coll. no. 49.	Benthall Edge, near Ironbridge.
	62_2.	Railway-cutting, side of Severn, Ironbridge.

3. *Cythere? subquadrata*, sp. nov.
(Pl. VII. figs. 6 *a*, 6 *b*, 14 *a*, 14 *b*.)

		Length.	Height.	Thickness.
Proportions:	Fig. 14 :	$16\frac{1}{2}$	10	8
	Fig. 6 :	15	9	6

Carapace high and short, convex, suboblong, with rounded unequal ends; higher and thicker at the hinder third than in front, where it is compressed.

The two specimens figured differ a little in outline and contour, but seem to be within the limits of one species. They remind us of *Cythere? obtusa*, J. & K. (Ann. & Mag.

Nat. Hist. for October 1886, p. 266, pl. ix. fig. 12), in general appearance; but they are not identical with it.

Twelve specimens:
Vine Coll. no. XIII. Bed no. 38. Buildwas Beds.
LIV$_4$ (fig. 14) } Bed no. 37.
LIV$_6$ (fig. 6) } Buildwas Beds.
LXIV$_{8,\,9}$. Buildwas Beds.

V. Cytherella, Jones and Bosquet, 1849.

Cythere, Cytherina, Cytherella, &c., auctorum.

In the 'Monograph on Carboniferous Entomostraca,' Palæont. Soc. 1884, by Jones, Kirkby, and Brady, the synonyms of the genus are given in full, and the characters and distribution of the many known species (both fossil and recent) are dealt with.

Carapace oblong or subovate, rarely elongate, compressed, especially in front; valves thick and unequal, the right being much the larger and overlapping the left all round, the two edges being rabbeted together. Surface often smooth, but sometimes pitted, reticulated, or striated. Muscle-spot indicated by a roundish depression near the centre of the valve externally and by a corresponding thickening within.

1. *Cytherella Smithii*, sp. nov.
(Pl. VII. figs. 15 *a*, 15 *b*, 16 *a*, 16 *b*.)

		Length.	Height.	Thickness.
Proportions:	Fig. 16 :	12	$6\frac{1}{2}$	5
	Fig. 15 :	11	6	5

Two specimens measured in 1000ths of an inch:—

24	14	
22	12	10

The little specimens before me belong to the group having smooth valves, subovate or suboblong in outline, and with a more or less cuneiform contour (edge view). Some specimens have the usual central pit on the outside of the valves; some are also constricted across the middle of the smaller valve, and these are narrower (lower) posteriorly than most of the others, with a variable median convexity. May be these are varietal or sexual differences.

Narrow as the limits of difference seem to be at first sight among the very many almost similar forms of *Cytherella*, yet the different proportions of length, breadth, and thickness, with small variations of outline, constitute recognizable distinctions among even the smooth forms. On such

grounds I distinguish this oldest-known form by a separate appellation—*C. Smithii*—after Mr. Smith, of Kilwinning, in whose collection this species is largely represented.

Smith Coll. (six specimens) no. 63. Woolhope.

VI. Primitia, Jones & Holl, 1865.

(See Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. p. 415, and ser. 5, vol. xvii. p. 408, &c.)

1. *Primitia punctata*, sp. nov. (Pl. VII. figs. 9 *a*, 9 *b*.)

Proportions :—L. 19. H. 10.

Long-oblong carapace, with rounded, nearly equal ends; rather small, plump, nearly oval in edge view. Surface of valves marked with a faint saddle-shaped depression in the mid-dorsal region, and delicately punctate, especially on the posterior third. On the cast of the interior the impression becomes a deep transverse sulcus, reaching nearly across the valve, and with a width equal to $\frac{1}{7}$th of the length of the shell.

P. punctata is found in Mr. Smith's no. 67 (four specimens). Railway-cutting near Much-Wenlock; and Vine Coll. LXV$_{11\,\text{(part)}}$ (one specimen). Shales over the Wenlock Limestone. Two also from no. 22. Buildwas Beds.

2. *Primitia valida*, J. & H.
(Pl. VI. fig. 7, magnified 50 diam.)

Primitia valida, Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. (1886), p. 409, pl. xiv. fig. 7.

Proportions :—L. $22\frac{1}{2}$. H. $14\frac{1}{2}$.

This well-preserved left valve, showing its hinge-line and the rest of its margin of contact, and partially its interior, was at first inadvertently associated with *C. Hollii* (figs. 5 and 6); but it is more quadrate and symmetrical and otherwise different. So also it is much more oblong than the analogous interior of *P. umbilicata*, J. & H. (Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. pl. xiii. fig. 2 *d*).

In the Vine Coll. no. LXIII. Bed no. 25. Tickwood Beds. Altogether there are seventeen specimens of *P. valida* (without the varieties) in the Vine Collection and six in the Smith Collection.

VII. *Incertæ sedis.* (Pl. VI. figs. 8 *a*, 8 *b*.)

Proportions :—L. 19. H. 10. Th. of valve 5 (of carapace 10).

An oval valve with a flexuous, undulate, and broadly bisulcate surface; and thus somewhat like the *cast* of *Cythe-*

rellina siliqua figured in pl. xiv. fig. 6 *c*, Ann. & Mag. Nat. Hist. ser. 4, vol. iii.

One specimen. Vine Coll. no. XIV_2. Bed no 43, Coalbrook-Dale Beds.

VIII. Note.—Prof. G. Lindström, of Stockholm, has kindly submitted to me for examination a large assortment of Ostracoda from the Silurian Limestones of Scandinavia. With numerous specimens of *Beyrichiæ* and *Primitiæ*, and of *Thlipsura v-scripta*, there appear to be some specimens of *Pontocypris Smithii*, *Bythocypris concinna*, and *B. Hollii* (?); also a small representative of *Macrocypris Vinei* (?). He has also found some interesting *Æchminæ* and other rare forms in these limestones.

IX. EXPLANATION OF THE PLATES.

Plate IV.

[All the figures magnified 25 diameters.]

Fig. 1. *Macrocypris Vinei*, sp. nov. Cast, imperfect posteriorly. *a*, left valve outwards; *b*, ventral view; *c*, end view.

Fig. 2. The same. Cast, imperfect at hinder end. *a*, right valve shown; *b*, edge view.

Fig. 3. The same. *a*, left valve outwards, slightly imperfect in front; *b*, edge view.

Fig. 4. *Pontocypris Mawii*, sp. nov. *a*, left valve outwards; *b*, right valve outwards; *c*, edge view; *d*, end view.

Fig. 5. *Pontocypris Smithii*, sp. nov. *a*, left valve outwards; *b*, right valve outwards; *c*, ventral view; *d*, dorsal view.

Fig. 6. *Pontocypris Mawii*, sp. nov., var. *gibbera*, nov. *a*, right valve outwards; *b*, edge view; *c*, end view.

Fig. 7. The same. Left valve outwards.

Plate V.

[All the figures magnified 25 diameters.]

Fig. 1. *Bythocypris Hollii*, sp. nov., ♂. *a*, right valve outwards *b*, ventral view; *c*, hind view.

Fig. 2. *Bythocypris Hollii*, sp. nov., ♀. Left valve outwards.

Fig. 3. *Bythocypris Phillipsiana*, J. & H., var. *major*, nov. *a*, right valve outwards; *b*, left valve outwards.

Fig. 4. *Bythocypris Phillipsiana*, J. & H. *a*, right valve outwards; *b*, ventral view; *c*, front view.

Fig. 5. *Bythocypris testacella*, sp. nov. *a*, right valve outwards; *b*, ventral view; *c*, end view.

Fig. 6. *Bythocypris concinna*, sp. nov. *a*, left valve outwards; *b*, right valve outwards; *c*, edge view; *d*, end view.

Fig. 7. *Bythocypris concinna*, sp. nov., var. *ovalis*, nov. Right valve outwards.

Fig. 8. *Macrocypris elegans*, sp. nov. *a*, right valve outwards; *b*, ventral view; *c*, hind view.

Fig. 9. *Macrocypris siliquoides*, sp. nov. *a*, right valve outwards; *b*, dorsal view; *c*, front view.

Fig. 10. *Macrocypris? alta*, sp. nov. *a*, right valve outwards; *b*, edge view.

Plate VI.

[Fig. 7 magnified 50 diam., the others 25 diam.]

Fig. 1. *Bythocypris? reniformis*, sp. nov., ♂. *a*, left valve outwards; *b*, ventral aspect.
Fig. 2. *Bythocypris? reniformis*, sp. nov., var. *a*, left valve shown; *b*, ventral view.
Fig. 3. *Bythocypris Hollii*, sp. nov., ♀. *a*, left valve outwards; *b*, dorsal view.
Fig. 4. *Bythocypris Hollii?*, sp. nov. *a*, left valve (rather crushed); *b*, ventral edge.
Fig. 5. *Cythere Hollii*, sp. nov., var. *a*, or ♂. *a*, left valve shown; *b*, dorsal view; *c*, posterior view.
Fig. 6. *Cythere Hollii*, sp. nov., var. *b*, or ♀. *a*, left valve outwards; *b*, dorsal view; *c*, posterior view.
Fig. 7. *Primitia valida*, J. & H. Interior of left valve (magnified 50 diam.).
Fig. 8. Incertæ sedis. *a*, right? valve; *b*, edge view.
Fig. 9. *Bythocypris? seminulum*, sp. nov. *a*, right? valve outwards; *b*, edge view.
Fig. 10. *Bythocypris acina*, sp. nov. *a*, left valve outwards; *b*, dorsal view.

Plate VII.

[All the figures magnified 25 diameters.]

Fig. 1. *Cythere? Vinei*, sp. nov., ♂. *a*, right valve seen; *b*, edge view.
Fig. 2. *Bythocypris botelloides?*, sp. nov. *a*, right? valve seen; *b*, ventral view.
Fig. 3. *Bythocypris symmetrica*, sp. nov., var. *c*. *a*, left valve seen; *b*, dorsal view.
Fig. 4. *Bythocypris symmetrica*, sp. nov., var. *b*. *a*, left valve seen; *b*, dorsal view.
Fig. 5. *Cythere? Vinei*, sp. nov., ♀. *a*, right valve seen; *b*, dorsal view.
Fig. 6. *Cythere? subquadrata*, sp. nov. *a*, right valve; *b*, edge view.
Fig. 7. *Bythocypris symmetrica*, sp. nov., var. *a*. *a*, right valve outwards; *b*, dorsal view.
Fig. 8. *Macrocypris symmetrica*, sp. nov. *a*, right valve outwards; *b*, dorsal view.
Fig. 9. *Primitia punctata*, sp. nov. *a*, left? valve seen; *b*, edge view.
Fig. 10. *Macrocypris? crassula*, sp. nov. *a*, left valve outwards; *b*, edge view.
Fig. 11. *Bythocypris phaseolus*, sp. nov. *a*, left valve outwards; *b*, dorsal view.
Fig. 12. The same. *a*, left valve outwards; *b*, ventral view.
Fig. 13. *Bythocypris pustulosa*, sp. nov. *a*, right valve outwards; *b*, ventral view.
Fig. 14. *Cythere? subquadrata*, sp. nov. *a*, right valve; *b*, edge view.
Fig. 15. *Cytherella Smithii*, sp. nov. *a*, left valve outwards; *b*, dorsal view.
Fig. 16. *Cytherella Smithii*, sp. nov., var. *a*, left valve outwards; *b*, dorsal view.

XXVI.—*On the* Cetoniidæ *of Japan, with Notes of new Species, Synonymy, and Localities.* By GEORGE LEWIS, F.L.S.

THIS family, so far as is known at present, is represented in Japan by twenty-four species. Mr. Waterhouse, in the Trans. Ent. Society, 1875, recorded fourteen species, but one of these, *Glycyphana Sieboldi*, Voll., is now given as a synonym, and another, *Trichius fasciatus*, Linn., appears to have been recorded as Japanese by Motschulsky in error. Twelve species, therefore, have been recently added, bringing the number to about one third of those in Europe; but there are nine genera in Japan to only six on the Continent.

Judging from the records of the literature relating to the Cetoniidæ it would appear that naturalists have been unable to master the specific characters of the group. Thus *Cetonia aurata*, Linn., *C. floralis*, Fabr., and *C. floricola*, Herbst, have, according to the Munich Catalogue, 87 names to represent the types and their varieties, and *Trichius abdominalis*, Ménétr., has 18.

For these 105 names we find about 40 sponsors. The commoner the species the more numerous the titles, and it appears therefore fortunate when a species is unique. An author cannot give two names to one specimen, although, if not properly labelled, it may obtain a second on changing ownership.

A reference to the 'Zoological Record' will show that recently, to increase the confusion, writers have initiated "*probable*" synonyms. Harold says (C. R. Ent. Belg. xxiii. p. 5), "that *Cetonia Bensoni*, Westw., probably = *Glycyphana pilifer*, Motsch.;" Schaufuss records (Nunq. Ot. iii. p. 560), "that probably *Protelia* (sic) *brevitarsis*, Lewis, = *Cetonia submarmorea*, Burm.*;" Kraatz tells us (Deutsch. ent. Zeit. xxvii. p. 317) that "*Micropœcila Bremeri*, Jans., probably = *M. cincta*, Gory, ♀;" and in another place, "*Diphognatha incoides*, Thoms., probably = *D. admixa*, Hope."

Italics are insufficient to indicate these speculations, and capitals are too distinctive.

Of the 105 names given above 101 stand, as stated, as synonyms in Harold's Catalogue; but it is impossible not to doubt that these may require revision, for is it possible to unravel such a tangled mass of nomenclature in its entirety?

* Schaufuss misquotes here; the sentence should read: "probably *Cetonia brevitarsis*, Lewis, = *Protætia submarmorea*, Burm."

The bright colours of the group have perhaps attracted the attention of some entomologists who, to say the least, have unwisely written on the family without sufficient previous study, or without the material adequate to the occasion. A glance at the Munich Catalogue and the pages of the 'Zoological Record' since 1880 should suggest to writers that great care is necessary to prevent the literature of the Cetoniidæ drifting into hopeless confusion. The "Ein Stück," which appears but too often at the foot of a description in Harold's paper on the Japanese Coleoptera, has been doubtless the means of misleading authors, who in a variable group have formed species on single specimens.

As an instance of work done on scanty material the three species of *Anomala* described as new by Harold (Deutsch. ent. Zeitschrift, xxii. pp. 351–353) may be given. Shortly after the publication of the paper Harold wrote to me to say the species were *Anomala rufocuprea*, Motsch., *Euchlora multistriatus*, Motsch., and *Anomala geniculata*, Motsch., respectively—insects which for their class are, and were then, well known.

The synonymy of the Cetoniidæ is added to, as I say, from their conspicuousness and the desire of entomologists to connect their names with them, while a less attractive family has a simpler catalogue. *Ceratorrhina viridipyga*, Lewis, is at once given a second name, *C. chloropyga*, Thomson, when names of similar compounds (*lævipygum*, *tuberculipygus*) in the Histeridæ are numerous and are allowed to remain single. The name of *C. viridipyga*, Lewis, will always be given priority, and *chloropyga*, Thomson, will always stand as a synonym, and a full reference to the beetle will require the mention of both names and a second line in the schedule. And in this instance has there been sufficient cause to add this line to our overburdened Catalogue? *Pyga* is a Latin word, and this Thomson does not seem to know.

1. *Rhomborrhina unicolor*, Motsch.

Rhomborrhina unicolor, Motsch. Etud. Ent. 1861, p. 8.

This species occurs not rarely in the north of Japan, but it is scarce in Kiushiu.

2. *Rhomborrhina polita*, C. Waterh.

Rhomborrhina polita, C. Waterh. Trans. Ent. Soc. 1875, p. 113.

The localities for this insect are Bukenji, where it is common in August, Kadzusa, and the island of Sado.

3. *Rhomborrhina japonica*, Hope.

Rhomborrhina japonica, Hope, Trans. Ent. Soc. iii. 1841, p. 64.
Rhomborrhina clypeata, Hope.
Rhomborrhina squammulifera, Thoms.
Rhomborrhina glauca, Thoms.

This variable species is extremely abundant, and on one tree Mr. Pryer has taken 125 specimens in twenty-four hours. The three species follow the *cossus* for the sake of the exuding sap caused by the larvæ.

There is a beetle known to the Japanese as the Shikamushi, or "stag-beetle;" the horns are said to be fixed, and a specimen of *Dicranocephalus*, taken to Japan, has been identified as resembling it. The Lucanidæ are vulgarly termed "scissor-beetles," as their mandibles open and close.

1. *Cetonia confusiusana*, Thoms.

Cetonia confusiusana, Thoms. Typi Cetonidarum, p. 28 (1878).

The pygidium in the male is reflexed at the apex and very convex, and resembles a boss in form; but the female is only transversely impressed, somewhat unevenly on both sides. In colour this species varies from a deep crimson to bronze and green, and is very common in S. Japan, but I did not find it in Yezo. I believe the brighter examples have been mistaken for *C. speculifera*, Swartz, which has been hitherto only found in China and the Philippine Islands.

2. *Cetonia submarmorea*, Burm.

Cetonia submarmorea, Burm. Handb. iii. p. 490.

The male of this species has an abdominal groove.

3. *Cetonia brevitarsis*, Lewis.

Cetonia brevitarsis, Lewis, Ann. & Mag. Nat. Hist. 1879, iv. p. 463.

This species is found in Japan, as far north as Kioto. The pygidium is very slightly convex and superficially even, and is quite distinct in form from that of *C. confusiusana*. There is a series in the British Museum from Korea.

4. *Cetonia insperata*, Lewis.

Cetonia insperata, Lewis, Ann. & Mag. Nat. Hist. 1879, iv. p. 463.

I took about thirty examples in Yezo. Vries Island, Chiuzenji, Nikko, Wada-togé are other localities for it.

5. *Cetonia Lenzi*, Harold.

Cetonia Lenzi, Harold, Abh. Ver. Brem. v. p. 128 (1876).

The thorax in this species is raised longitudinally in the

centre, and is thus divided into two equal parts; the pygidium is the same as in *brevitarsis* and *insperata*. I obtained six specimens in June at Kioto.

6. *Cetonia pilifer*, Motsch.

Glycyphana pilifer, Motsch. Etud. Ent. 1860, p. 15.

Common everywhere.

7. *Cetonia Roelofsi*, Harold.

Glycyphana Roelofsi, Harold, C. R. Ent. Belg. xxiii. p. 5 (1880).

Not very common, occurs at Miyanoshita and Nikko.

1. *Glycyphana forticula*, Janson.

Glycyphana forticula, Janson, Cist. Ent. ii. 1881, p. 607.

Is at present unique in Mr. Janson's collection.

2. *Glycyphana jucunda*, Fald.

Glycyphana jucunda, Fald. Mém. Ac. Petr. ii. p. 386.
Glycyphana Goryi, Guérin.
Glycyphana argyrosticta, Burm.
Glycyphana Kuperi, Schaum.
Glycyphana albosetosa, Motsch.

I believe the names above refer to one species, and that this is the view also taken by Harold, Janson, and others. *G. jucunda*, I have taken abundantly in Shanghai, the examples there generally having a broad red fascia on each elytron. *G. albosetosa* is a black form of the species, and comes chiefly from Yezo; it is the most abundant species of the family in Japan.

3. *Glycyphana fulvistemma*, Motsch.

Glycyphana fulvistemma, Motsch. Schrenck's Reis. 1860, p. 135.
Glycyphana Sieboldi, Voll. 1864.

This is of common occurrence, particularly at Kobe and Nikko.

1. *Anthracophora rusticola*, Burm.

Anthracophora rusticola, Burm. Handb. iii. p. 624.
Anthracophora rama, Bainbridge, 1842.
Anthracophora sinensis, Saunders, 1852.

This species is common in Kiushiu, but has not yet been observed north of Kioto.

1. *Osmoderma opica*, Lewis.

Osmoderma opica, Lewis, Wien. ent. Zeitung, 1887.

This is probably the species taken by Dr. Hoffmann in Tokio, and recorded by Von Harold as *barnabita*, Motsch. (Deutsche ent. Zeitschrift, xxii. Heft i. p. 12).

1. *Gnorimus viridiopacus*, Lewis.

Gnorimus viridiopacus, Lewis, Wien. ent. Zeitung, 1887.

Found at Chiuzenji rather late in the summer. Three examples.

2. *Gnorimus subopacus*, Motsch.

Mr. Bowring obtained this species many years ago on the island of Tsushima, and I have five examples from the same locality, taken in 1881. I also took one at Sapporo.

1. *Paratrichius Donitzi*, Harold.

Paratrichius longicornis, Janson, Cist. Ent. ii. p. 611, pl. xi. fig. 1 (1881), = *Gnorimus Donitzi*, Harold.

The latter name has the priority, but the generic name proposed by Janson it is well to retain. I bred the species from pupæ in June, and found the imagos in flowers in August on the high ranges bordering the mountain-forests on Oyayama, Niohosan, Ontake, and Wada-togé. Janson records it from Yezo.

The females are always black, but the males vary in colour and look very much like *Trigonopeltastes*. There is one male with the elytra almost wholly black.

1. *Trichius japonicus*, Janson.

I obtained this species from *Deutzia*-flowers at Nikko in June 1880, and this appears to be its most southern locality. On August 7, same year, it was abundant at Sapporo, in the umbels of the gigantic *Angelica*, where, being some feet out of reach and very active on the wing, it was difficult to capture in an inverted umbrella. *Trichius fasciatus*, L., has been reported erroneously from Japan instead, possibly, of this insect.

2. *Trichius succinctus*, Pallas.

Trichius succinctus, Pallas, Ic. Ins. p. 18, t. A. fig. 19; Burm. Handb. iii. p. 758.

This species is recorded here from Japan for the first time. It occurred on Oyayama and at Nikko and Sapporo, but only eight examples were taken, so it must be considered rare in Japan.

3. *Trichius septemdecimguttatus*, Voll.

Trichius septemdecimguttatus, Voll. Tijdschr. Ent. Nederl. vii. 1864, p. 159; C. Waterh. Trans. Ent. Soc. 1875, part i. p. 71, pl. iii. fig. 8.

This species is only at present known from the island of Kiuskiu. It was found not uncommonly in *Viburnum*-flowers at Konosé, May 19, 1881, and about twenty specimens were dug out of an old log (*Planera*) the same day, five of which

are wholly red. With the latter were captured about twenty examples of *Figulus binodulosus*, C. Waterh. (Trans. Ent. Soc. 1883, p. 339). This is a curious record of the meeting in a common habitat of a northern and a tropical genus.

1. *Valgus angusticollis*, C. Waterh.

This species, as Mr. Waterhouse states, is common in all the Japanese islands. On the 13th March, 1880, I broke up a pole of "Matzu" (*Abies*), 4 inches in diameter, and quite rotten, and about fifty specimens tumbled out. Later it occurs in most flowers, but especially in the rape-fields and dog-roses.

2. *Valgus fumosus*, n. sp.

Breviter ovatus, ater, ocellato-punctatus, subnitidus; thorace parum lato medio bicarinato, utrinque excavato; elytris lateribus punctatis, mediis punctato-rugosis, scutello circum et fascia transversa luteis; propygidio transverso luteo-fasciato, utrinque acute tuberculato; pygidio medio longitudinaliter anguste fasciato, apice inconspicue bituberculato, tibiis anticis 2-dentatis. L. $7\frac{1}{2}$ mill.

This species resembles *V. tuberculatus* only in the acute tubercle on the edge of the propygidium. The whole of the species is densely black ornamented with orange-coloured scales, which are arranged on the elytra in a broad band round the scutellum, with another transverse band which touches the edge of the first fascia and extends to the middle of each elytron from the suture, on the propygidium in a parallel transverse band, and on the pygidium in a longitudinal and narrow band down the centre. The thoracic carinæ are somewhat loop-like in form and terminate abruptly behind the neck in two obtuse angles; in front of the lateral excavations on each side is a tubercle or very short carina, and the base of the thorax has a well-marked excavation before the scutellum. The outer edge of the thorax is narrowly elevated and deeply sinuated behind the eyes. The yellow fasciæ are composed of rather large scales, and are apparently easily lost by abrasion, but the description is drawn from an example fresh from the pupa. The two teeth on the fore tibia are near to the femur.

Found in the flowers of *Hydrangea*, at Junsai, 28th July, 1880; Fukushima, Ontake, and Chiuzenji, in 1881. Five specimens in all.

3. *Valgus tuberculatus*, n. sp.

Breviter ovatus, granulosus, rufo-piceus, subnitidus; thorace parum angustato, 8-tuberculato; elytris castaneis, mediis obscure nigro-

plagiatis; propygidio utrinque tuberculato, medio bituberculato approximato; tibiis anticis 4-dentatis; pedibus rufis. L. $7\frac{1}{4}$ mill.

This species, although it has allies in Eastern Asia, is very different from either of the preceding. In the middle of the anterior part of the thorax there is a loop-like carina terminating posteriorly in two acute and well-defined tubercles, and between each of these and the lateral edge is another somewhat obsolete tubercle. The base of the thorax is transversely occupied by four large equidistant tubercles, which are covered with flavous spinose scales. The scutellum is black. The elytra are nearly quadrate, castaneous, with coarse spines on the humeral and corresponding apical angles, and in the middle are two large ill-defined patches of black spinose scales. The propygidium has two tubercles in the middle, clothed like the basal thoracic ones, and at the outer apical edge on either side is a remarkable tooth, very acute and free of scales. At the extremity of the pygidium are two tufts of flavous scales or spines, which apparently cover two small tubercles.

Found at Fukushima, July 28, and at Kurigahara Usuitogé, August 6, 1881. From the dates of capture given here *V. tuberculatus* and *V. fumosus* seem to appear much later in the year than *V. angusticollis*; and if so, their late appearance may be an indication that they belong to the more tropical forms of the genus. Still, as they are evidently scarce, the time of capture may be merely incidental to the time of my visit to their localities. One thing, however, is certain, that *V. angusticollis* is, as Mr. Waterhouse has stated, allied to the northern and European species *hemipterus*.

List of Species arranged generically.

Rhomborrhina unicolor, *Motsch.*
—— polita, *C. Waterh.*
—— japonica, *Hope.*
[clypeata, *Hope.*
squammulifera, *Thoms.*
glauca, *Thoms.*]
Cetonia confusiusana, *Thoms.*
—— submarmorea, *Burm.*
—— brevitarsis, *Lewis.*
—— insperata, *Lewis.*
—— Lenzi, *Harold.*
—— pilifer, *Motsch.*
—— Roelofsi, *Harold.*
Glycyphana forticula, *Janson.*
—— jucunda, Fald.
[Goryi, *Guérin.*
argyrosticta, *Burm.*
Kuperi, *Schaum.*
albosetosa, *Motsch.*]
Glycyphana fulvistemma, *Motsch.*
[Sieboldi, *Voll.*]
Anthracophora rusticola, *Burm.*
[rama, *Bainbridge.*
sinensis, *Saunders.*]
Osmoderma opica, *Lewis.*
Gnorimus viridiopacus, *Lewis.*
—— subopacus, *Motsch.*
Paratrichius Donitzi, *Harold.*
[longicornis, *Janson.*]
Trichius japonicus, *Janson.*
—— succinctus, *Pallas.*
—— septemdecimguttatus, *Voll.*
Valgus angusticollis, *C. Waterh.*
—— fumosus, *Lewis.*
—— tuberculatus, *Lewis.*

XXVII.—*On the Position of the Ampullaceous Sac and the Function of the Water Canal-system in the Spongida.* By H. J. Carter, F.R.S. &c.

What we want to know in the class of Sponges, after their *specific* description, is a general conception of the manner in which the different parts of which they are composed are developed, and the way in which their vital functions are performed. In the first instance a useful classification is needed, by which the species may be easily determined: this is the department of the naturalist, and, as a matter of course, precedes all others. The second and third points come under the domain of the physiologist, and here the general plan of development and that of the general way in which the vital forces are maintained (excepting, for a time, their peculiarities) is the primary desideratum. But although the first is a *sine quâ non* to the latter, it leads to nothing but a collection of curiosities so long as the physiological part remains unknown.

Of course there is much yet to be discovered in the study of a subject so comparatively young as that of spongology, and it is only by numerous contributions arising from a special study of particular parts that this can ever be advanced, and therefore, however restricted the inquiry may be, so long as it tends to elucidate any particular point, the result must be considered acceptable. In the present instance it is the position of the ampullaceous sac in relation to the water-courses or canalicular structure of the sponge to which I wish to direct attention.

The ampullaceous sac (" Geisselkammer " of the Germans) is for the most part spherical in form, consisting of a hollow, thin, transparent sphere of plastic sarcode whose wall is charged with spongozoa (" Geisselzellen " of the Germans), arranged tesserately, that is side by side, or in juxtaposition; the spheroidal form being truncated or cut off, that is absent at one part, whereby a sharply defined circular aperture is produced which opens on a level with the surface of a water-canal, while the other part is imbedded in the substance (plastic connective tissue &c.) of the sponge immediately underneath. Thus the ampullaceous sac so far resembles the position of a polyp in its fleshy dermal substance; but here the analogy ceases.

I have long since stated (1857) that, when treated with a solution of carmine (that is, of carmine water-colour paint) in the living state, the ampullaceous sacs are the only parts in

the sponge which take in this colouring-matter, and that, when they are torn to pieces in this state, the carmine paint is found to be in the bodies of the spongozoa.

Further, it was added that it was possible to see the fragments of carmine paint drawn in through the pores on the surface of the sponge, and then, after a break in which they could not be followed, to see them enter the circular opening of the ampullaceous sac, after which they again disappeared for a short interval (probably during the time that the germ or nutritive part of the paint was being abstracted), when fragments of colouring-matter could be seen rushing along the larger excretory canals, and finally ejected at the single vent, as the particle of growing sponge under observation then consisted of only one "person" (Häckel), and therefore had only one vent.

Thus I never could follow the particles of carmine from the subdermal cavities to the ampullaceous sacs, nor observe the discharged particles coming out of this sac, although my mpression was that they were forced out through the same aperture by which they were taken in.

The ampullaceous sac is not always spherical nor are the spongozoa always grouped into this form, but may vary in number from one to several placed here and there on the surface of the water-cavities or canals, whereby the carmine or indigo paint (for either can be used for this purpose) may be found at isolated points in the sponge-substance apart from the ampullaceous sacs; so that it might be inferred that the ampullaceous sacs are not, as above stated, the only parts which thus take in nutriment; but it should be remembered that it is not the ampullaceous sacs but the spongozoa which do this, and therefore that it is not uncommon to find spongozoa isolated singly or in small groups of different sizes charged with the colouring-matter.

With reference to the passage of the particles of carmine into the sponge through the pores of the surface and the parts into which they may be subsequently received, it might be stated that, so far back as 1869 ('Annals,' vol. iv. p. 191, pl. vii. fig 5), I described and delineated the fact that in *Grayella cyathophora*, where the pores on the surface of this siliceous sponge are confined to *circumscribed* pustuliform areas, the area may open directly into an "excretory canal;" and in 1885 (*ib.* vol. xv. p. 112, pl. iv. fig. 5) such observations were repeated in *Halichondria scabida*; while in the interval, viz. in 1879, I pointed out that in *Axos spinipoculum* the pores of the surface lead directly into an excretory canal through the subdermal cavities. Thus it became

evident that they were for the purpose of admitting water into the sponge as well as the nutrient particles which it might contain. Further confirmation of this was adduced by instancing the calcareous sponge *Teichonella labyrinthica*, wherein the wall is composed, as in the Sycones generally, of hollow cylindrical chambers arranged transversely across it and in juxtaposition, so that the pores are at one end and the vent at the other, viz. on either side of the wall, respectively, while the interior of the chamber is studded all over with spongozoa ('Annals,' 1885, vol. xv. p. 119, pl. iv. fig. 7 &c.). At this time also I cited two other cases in Psammonematous sponges, viz. in *Geelongia vasiformis* and *Hircinia intertexta*, where the pores of the surface opened directly into large excretory canals, that is, of course, through the medium of the subdermal structure. Next, viz. in 1886, I found it most convincingly in a remarkable sponge from "Port Phillip Heads" described under the name of *Suberites insignis* ('Annals,' vol. xvii. p. 118), wherein the "sinus-like dilatations of the excretory canal-system" are only separated externally from the water by the poriferous epidermis and subjacent subdermal cavities which lie over them at this part. Finally, in 1886, I described and illustrated this in *Phlœodictyon birotuliferum*, where the digital appendages of this sponge are tubular and hollow, and their wall *alone* formed of the poriferous and subdermal structures, without, so far as I can see, the trace of an *ampullaceous sac*, so that the water, with its nutrient particles, must pass directly into the cavity of the process, and the nutrient particles be deflected to their destination afterwards, which probably was in the body of this sponge, of which I only possessed the tubular appendages for description. Moreover, the *inner* surface of the wall is covered with a layer of epithelial cells like those of the surface.

[It might be here stated that the "skin" of a sponge, so to call it, generally consists of an epidermal or poriferous layer and the subdermal cavities or subdermal structure—the former very thin and composed of a layer of epithelial cells, in which the pores are situated, and the latter comparatively thick and composed of a cancello-clathro-fibro-membranous structure, in which the intervals all communicate with each other; that is, it would be a continuous hollow subdermal cavity but for the presence of this structure. Then comes the body-substance of the sponge, in which the ampullaceous sacs begin to appear. It is the "skin" *only* which forms the wall of the poriferous tubular processes of *Phlœodictyon birotuliferum*.]

All this shows that the pores are as much for aqueous circulation as for the introduction of nutritive material.

This having been established, let us now endeavour to trace the nutrient particles from the excretory canals into the ampullaceous sac, and this can be best inferred by finding out the position of the ampullaceous sac and its relation to the excretory canals.

When describing in a general way the structure of a sponge, in the introductory remarks to the order Psammonemata among Mr. Wilson's Australian specimens ('Annals,' 1885, vol. xv. p. 209), it was observed that "what has been stated of the external parts of the sponge applies *cæt. par.* to the internal ones or parenchyma; for as the sponge grows by the addition of layers to its circumference, that is radiatingly, so the surface of to-day becomes part of the internal structure of to-morrow, and thus somewhat modified it passes into a cancellated form, which is the parenchyma; that is to say, the fibrous skeleton, cored by mineral material or not, becomes a solid mass of reticulation, in which the interstices are tympanized by the *still* poriferous sarcode (as may be seen in a dried specimen), and the cancellated chambers thus completed. Lastly, the whole is traversed by the branches of the excretory canal-systems. I use the latter in the plural number, because generally every vent indicates a system."

Now here, if I had had the information which I now possess, it might have been added that the "tympanizing sarcode" was charged with ampullaceous sacs and pierced by a number of pores or small holes, which would have so far completed the general description of sponge-structure. But this information has come to me since, partly from a microscopic examination of the tympanizing sarcode in a dry specimen, and partly from that of a small wet one closely allied to *Wilsonella australiensis*, which will be more particularly described hereafter.

In this small specimen, which hardly exceeds in size an inch each way, the ampullaceous sacs, averaging 20 to 30-6000ths in. in diameter, are unusually well preserved, apparently from natural toughness; but be this as it may, they present themselves under a clear form in which their general outline, as well as that of the spongozoa of which they are composed, is sharply defined; moreover they stain well with blue aniline ink, and in comparatively thin slices, that is about 1-24th to 1-16th in. thick, become still more conspicuous under this treatment; so that when the slices are mounted in glycerine and viewed with a magnifying-power of about 90 diameters, in a cell *without* compression, the ampullaceous sacs can be distinctly seen to surround the water-canals, where they are more or less approximated, apparently unmolested,

entire, and *in situ*. Under these circumstances, when a water-canal is selected for observation which has been cut across horizontally so that the eye can be directed into it perpendicularly, one or more ampullaceous sacs may frequently be seen on the confines of the canal in such a position as to show that the greater part of the globular ampullaceous sac is imbedded in the substance of the sponge immediately under the lining membrane of the canal, while the circular aperture opens on a level with it, so that as the water containing the nutritive particles is rapidly carried along them, the latter could be easily deflected from their course and drawn into the ampullaceous sac, while the refuse or unassimilated parts might be discharged through the same aperture, just as takes place in a polyp.

Comparatively thick slices thus treated show the position of the ampullaceous sac more satisfactorily than microscopic thin slices mounted in balsam under compression, especially in the specimen under consideration, wherein their position is rendered additionally clear by not being overcrowded, although both processes have their advantages.

Now I know that in Dr. Huxley's 'Introduction to the Classification of Animals' (1869) a "hypothetical section of *Spongilla*" is given (p. 15, fig. 4), wherein the current of water is made to pass in at the pores and through the medium of the subdermal cavity to reach the ampullaceous sac by a canalicular extension of this cavity, after which it makes its exit by a similar opening on the opposite side of the sac into an excretory canal, as if the pores were specially intended for the ampullaceous sacs, that is for the nutritive department. While what I have endeavoured to show is, that the pores are as much for the general circulation or respiratory function as for the introduction of nutriment, and that the ampullaceous sac, being situated on the surface of the excretory canals, only requires a single aperture to fulfil its function.

I am also aware that Dr. F. E. Schulze has always inclined to the view that the ampullaceous sac has two openings, viz. one for bringing in the water and the other for discharging it, as may be seen by one of his latest illustrations ('Der Badeschwamm:' Illustrirte Deutsche Monatshefte, 1882, p. 198, fig. 8), as well as in all those of his previously stained and microtomized preparations of the fleshy and horny sponges published in the 'Zeitschrift f. wiss. Zoologie.' Moreover, in some there is more than one aperture in addition to the large circular or excretory one represented, amounting in *Spongelia avara* to "20–30" ("Die Gattung Spongelia," 1878, Zeitschrift f. wiss. Zoologie, Bd. xxxii. p. 134, Taf. viii. fig. 5).

I cannot say that microscopic slices of stained sponges, reduced to extreme thinness by the microtome and mounted in balsam, that is under compression, are to me so satisfactory as thicker slices simply stained and mounted in glycerine without compression, since in the latter the ampullaceous sacs may be seen in an unmolested state unaltered by any compression or microtomizing, that is entire and *in situ*. However, there is no objecting to what Schulze has illustrated any further than that it does not seem to me to convey such a general conception of an ampullaceous sac and its position in relation to the water-canal as that which I have seen under the circumstances above mentioned—that is, a globular water-vessel with no neck imbedded in the confines of a water-canal with the mouth opening upon the surface of that canal.

In the syconoid cylindrical chamber of the calcareous sponge *Teichonella labyrinthica*, which, as I have already stated, is homologous with the ampullaceous sac, there are not only two main openings, that is, pores at one end and a large single vent at the other, but the interior of the chamber is covered with spongozoa intermingled with a great number of other pores or smaller holes ('Annals,' 1885, vol. xv. p. 119, pl. iv. fig. 7 &c.), so that, in fact, it is so far precisely like that which Schulze has described and illustrated in the siliceous sponges. And this structure is continued on to *Leuconia nivea* and *Teichonella prolifera*, although the chambers are here so divided up as to resemble both in size and position the ampullaceous sac, which, together with the now tree-like form of the water canal-system opening as vents and pores respectively on the surface (as there is no cloaca in these species), renders the whole almost identical with that of the siliceous sponge.

I have stated that "there is no cloaca" in *Leuconia nivea* and *Teichonella prolifera*; but the fact is that the termination of the large canal of the water-systems respectively in all sponges is but a modified cloaca, and therefore those of *Leuconia nivea* and *Teichonella prolifera* must be considered the same; but for distinction sake it is necessary to separate them from those Calcispongiæ which possess that particular kind of ending of the excretory canal-systems which has been distinguished by the name of "cloaca," of which many similar instances exist in the adult forms of the siliceous sponges.

This, however, does not interfere with the fact that the admission of water for respiratory purposes, while it also carries in with it the elements of nutrition, is effected through the pores or inhalant orifices of the surface, while the discharge takes place at the vent or exhalant orifice at the other end of the cylindrical chamber.

Lastly, in a portion of tympanizing sarcode cut out from a dried fragment of *Geelongia vasiformis* and placed under a power of about 500 diameters, the ampullaceous sacs in juxtaposition, *although dry*, may be distinctly seen on the tympanizing sarcode with their circular apertures still open in many instances.

To return, however, to the position of the ampullaceous sac in the specimen of *Wilsonella* to which I have alluded, there can be no doubt that when brought into view in the interior of the sponge in a thin slice stained and mounted in glycerine, as above mentioned, it may be seen in more or less plurality and more or less approximated on the confines of the smaller excretory canals, where these have been so cut across as to enable the observer to look down into them. Instances then present themselves where the sharply-defined globiform ampullaceous sac may be seen to rest on its side in the substance (plastic connective tissue &c.) of the sponge immediately under the surface-membrane or epithelium of the canal with its circular mouth opening on a level with the latter.

As above stated also, the shape of the ampullaceous sac is not invariably globiform, but in *no* instance have I been able to see any other *canal* in connexion with it than that of the excretory system, on the surface of which the "circular aperture" opens. Nor have I in any instance been able to trace any canals leading directly from the pores on the surface into anything but the cancello-clathrate subdermal structure, *within* which the ampullaceous sacs, according to my observation, only begin *first* to appear, that is in the body-substance of the sponge.

Still, it has often appeared to me that the ampullaceous sacs, when grouped together in a massive form, are fixed in a kind of fibrous trama wherein they are connected with one another by tubular intercommunication, which may finally open upon the surface of an excretory canal. Nor have I been able to see the circular aperture in any of *these* instances, where it might have been hidden by the smallness of the excretory canal among the aggregated ampullaceous sacs. In short, I have never been able to see the circular aperture opening upon the surface of the excretory canal, excepting where the ampullaceous sac has been favourably situated for this purpose, as above mentioned.

I do not wish it to be inferred for a moment from what is above stated that I discredit anything that has been published by Dr. F. E. Schulze; indeed, what he has stated with respect to the incurrent and excurrent apertures of the ampullaceous sac is verified in the chamber of *Teichonella labyrinthica*,

which is the homologue of the ampullaceous sac in the siliceous sponges, as above shown. But I desire to put forth my own views of the position of the ampullaceous sac and its relation to the water-canals as deduced from the observations above mentioned.

Probably there *is* more than one aperture in the ampullaceous sacs in many instances, for I do not see how two could be represented in the *microtomized sections* unless this had been the case. Then, all I can state is, that there is probably an equal number of instances in which there is only one that serves both purposes, viz. for the inception of the nutrient particles and the exit of the refuse or unassimilated material; which could thus be as easily effected as in a polyp. I have already stated that I never could see any other vessel connected with the ampullaceous sac than the excretory canal.

It is very desirable, however, that more widespread observation on this subject should be made, for it appears to me that the species of *Wilsonella* which, in conclusion, I am about to describe, is an unusually favourable one for such observations. At the same time I must say that all the more important observations in the physiology of the Spongida that I have made have been obtained by studying *living* specimens directly and experimentally, which seems to me to be too much neglected now for the description and classification of dead species. But this, of course, necessitates a temporary residence near the places where the freshwater and saltwater species respectively grow. I *began* my study of the sponges in this way.

Wilsonella echinonematissima, n. sp.

Specimen small, without any particular form, being about an inch in diameter each way and composed of a mass of keratose, echinated skeletal fibre covered above by prominent conuli projecting from a smooth surface. Consistence firm, resilient. Colour sponge-amber. Surface even between the conuli, which are large, obtuse, distant, and prominent, tied together by the usual fibro-reticulated intervening structure underneath a thin layer of small epithelial cells. Pores grouped together in the epithelial layer over the interstices of the fibro-reticulated structure. Vents not seen. General structure from without inwards consisting of the thin epidermal layer, in which the pores are situated, overlying a comparatively thick one composed of cancello-clathrate fibrous membrane whose intervals intercommunicate with each other throughout, thus corresponding to the "subdermal cavities," resting upon the body-structure of the sponge, which in its

turn is composed of stiff keratose, profusely echinated fibre, densely reticulated and accompanied by the usual sarcodic or soft sponge-substance, the whole traversed by the branches of the excretory canal-system. Spicules of four forms, viz. :— 1, skeletal, acuate, smooth, slightly contracted between the obtuse end and the shaft, so as give the former a slightly inflated appearance, about 50 by 1-6000th in.; 2, echinating spicules of two sizes, viz. one, the longest, thickly spined about the obtuse or fixed end, scantily over the shaft, and smooth towards the pointed or free end, 35 by 2-6000ths in.; the other, the shortest, clavate, much spined about the fixed end, which spination then ceases or is followed by a comparatively smooth interval, and then by another spined portion in which the spines are vertical, after which it is smooth for about a quarter of the length of the spicule, that is to the end of the point, 19 by 2-6000ths in. exclusive of the spines, which add another 6000th to the thickness; 3, flesh-spicule, an equianchorate somewhat bent upon itself, rather obtuse at the ends, *i. e.* not navicularly shaped, 6-6000ths in. long by $2\frac{1}{2}$-6000ths in. across from the front arm to the back of the shaft. No. 1 forms the core of the keratose fibre, which is profusely echinated with both forms of no. 2, accompanied by the flesh-spicule no. 3. While the fibre of the body is exclusively that of an *Echinonema*, that towards the circumference becomes almost as exclusively that of a *Psammonematous* sponge charged with foreign bodies and terminating in a confused inflated mass at the end of each conulus.

Hab. ? Western Port.

Obs. This is a remarkable sponge, for although the specimen is so small as to be insignificant in size and form, yet it possesses characters which claim for it the title of a distinct species, for which I propose the name above given on account of the density of the echinating part of the spiculation. Here there can be no doubt of the structures of two orders appearing together in the same sponge, for the body-fibre is as essentially that of an Echinonematous as the circumferential or terminal part is that of a Psammonematous sponge, and they are not mixed together as in the fibre of *W. australiensis.* The anchorate is less navicular in shape, that is more obtuse at the ends and stouter, than that of *Wilsonella australiensis*, and the surface, instead of being smooth and overscattered with pustuliform vents, is conulated like that of a *Hircinia.* There seems, too, to have been a great tendency in its development to the formation of kerasine, for bodies as large as the cells of Polyzoa that have been in its proximity, and even the cells themselves of these animals, have become

attached to the fibre by an enveloping extension of the profusely *echinated* layer over them. But the most striking part of all is the sharply-defined and persistent character of the ampullaceous sacs, which, being comparatively scanty and more or less separated, besides possessing an unusual degree of toughness under manipulation, have enabled me to make with certainty the observations above mentioned.

P.S.—In the "Supplement" to the descriptions of Mr. Wilson's sponges, published in the 'Annals' of 1886, vol. xviii. p. 271, for "Port Western" read "Western Port." And for "*Histioderma*," p. 452 *et seq.*, read "*Histoderma*."

XXVIII.—*Description of a new Genus of* Stylasteridæ. By R. Kirkpatrick, Assistant, British Museum (Natural History).

[Plate VIII.]

The specimen described here was collected off Mauritius, and obtained from Mr. De Robillard. No information was sent concerning the depth at which it was found or the manner in which it was obtained.

Phalangopora, g. n.

Ramose Stylasteridæ with gastropores in a single linear series on the anterior and posterior surfaces of the branches of the colony; with dactylopores arranged in a single linear series on each lateral surface of each branch, and also irregularly scattered. Mouth of each gastropore overarched by a triangular scale; dactylopores with nariform projections. Both kinds of pores without styles?

Phalangopora regularis, sp. n. (Pl. VIII.)

Colony flabelliform; dichotomous branching fairly well indicated in parts; branches subcylindrical, flattened on anterior and posterior surface; parent branch 3 millim. in diameter, terminal branches 1 millim.; surface marked by wavy ridges running in a longitudinal direction; pores small, gastropores measuring ·5 millim. from side to side, ·3 millim. from before backwards, mouth opening obliquely and overhung by a triangular slightly convex scale with rounded apex; dactylopores oval in projection, slightly constricted in the middle, long diameter ·3 millim., transverse ·15 millim., height of nariform projections ·15 millim. Ampullæ hemispherical, 1·2 millim. in diameter.

Loc. Mauritius.

The new genus is allied to *Errina*, but differs from the latter in the regular arrangement of the pores, as indicated above.

In *Phalangopora* the separation of the gastropore and dactylopore systems is a further distinctive feature. For although in *Distichopora* there is a series of pores on each side of the branches, each series consisting of a central row of gastropores and two lateral rows of dactylopores, the differentiation of the two systems is not so marked as in *Phalangopora*, and there are no pores on the anterior and posterior surfaces.

The specimen is small, measuring 2 inches in height and 3 inches in breadth across the broadest part. Colour white, cœnosteum dense. The number of branchings is five or six; some branches are twisted on their axes.

The mode of branching seems to be dichotomous, but shows a tendency to the formation of a scorpioid cyme from the continual suppression of lateral branches on alternate sides.

Owing to the manner in which the corallum increases in thickness in the older branches, the dactylopores do not open along the median lateral lines, as they do in the terminal ones. Consequently on one surface of the flabellum the nariform projections are more conspicuous than on the other, so that the specimen may be said to have an anterior and posterior surface, the term "anterior" being applied to the former. The lateral dactylopores are contiguous in the younger branches and separated in the older; in one or two branches the irregularly scattered dactylopores almost form a linear series.

Viewing the anterior and posterior surfaces of the branches in profile, the scales arching over the mouths of the gastropores appear like lines of tiles.

On the youngest branches the scales lie strictly in the middle line, each scale rising from the upper border of the mouth of the preceding gastropore. In the older branches the gastropores are separated by a considerable interval, and a line joining them would be serpentine.

A longitudinal section of a young branch shows the wide canals of the gastropores cut across, also the long canals of the dactylopores passing in obliquely towards the centre. From the length of the gastro- and dactylopores the system of canals in the cœnosteum is not so well marked near the surface as in some Stylasteridæ.

It is not evident from the section whether styles are present in the gastropores or not; but a coarse dissection, in which the outer wall of the gastropores was removed down to the base, failed to show any evidence of gastrostyles.

Ampullæ are present on both surfaces, but are most numerous on the posterior surface. They graduate in colour from white, through varying shades of yellow, to deep yellow.

Although the specimen is small, as there are over eighty ampullæ present, the colony is most likely a young adult, and probably does not attain a much larger size.

EXPLANATION OF PLATE VIII.

Fig. 1. Specimen, enlarged $1\frac{1}{2}$. *a*, ampullæ.
Fig. 2. "Anterior" view of terminal branch. *a*, gastropore; *b*, dactylopore; *c*, one of the irregularly scattered dactylopores.
Fig. 3. Lateral view of same. *a*, scale of gastropore.
Fig. 4. "Posterior" view of same. The gastropores are not arranged typically, as in the other branches.
Fig. 5. Longitudinal section, magnified 12 diameters.

XXIX.—*Descriptions of new Species of Bombycid Lepidoptera from the Solomon Islands.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

THE following new species have recently been collected by Mr. C. M. Woodford in various islands of the Solomon group.

Agaristidæ.

1. *Eusemia splendida*, sp. n.

♂. Primaries above velvety black, brilliantly shot with ultramarine blue, changing to viridian green, excepting upon the borders; a dot near the base of the cell, a quadrate spot towards the end of the cell, two short parallel lines above the latter, an oblong spot beyond the cell on the last subcostal interspace, and a triangular bifid spot divided by the second median branch, pearly hyaline white; fringe at apex snow-white, otherwise dark grey: secondaries black-brown, shot with ultramarine blue; costal area cupreous brown, sericeous; a large oblong patch or central belt of bright orange from abdominal margin to subcostal vein. Head black, the face with a snow-white V-shaped marking behind the palpi; antennæ black; collar bright orange; thorax black shot with peacock-green; abdomen bright orange, with four bands and the anal tuft black shot with green. Wings below nearly as above, but the white spots on the primaries rather larger; a few white scales towards external angle. Pectus brown, bright ochreous in front; legs brown; venter orange, banded broadly with black throughout; anal and preanal segments wholly black. Expanse of wings 61 millim.

Guadalcanar

Nearest to *E. terminalis* and *E. endamoides*, but the markings of the primaries most like those of *Rothia eriopis* from Madagascar.

2. *Eusemia Woodfordii*, sp. n.

Black: primaries with five snow-white spots, the first elliptical, near the base of the interno-median interspace; the second oblique, subquadrate, crossing the cell near its extremity; the third placed obliquely below and beyond the second towards external angle, oval; a small spot above the latter; the fifth forming a large quadrate patch beyond the cell; in some specimens there is an additional small white cuneiform spot near the base of the cell: secondaries snow-white, with the base and borders rather broadly black. Abdomen of male with the basal half of its dorsal surface blackish, the anal half and entire ventral surface bright cadmium-yellow; abdomen of female greyish brown, with ochreous anal segment. Wings below as above, excepting that the white spots have greyish borders. Expanse of wings, ♂ 60 millim., ♀ 65 millim.

Alu, Shortland Island.

Allied to *E. vacillans*, but vaguely resembling *E. Hornimanni*.

3. *Ophthalmis aluensis**, sp. n. (possibly *Lithosia formosa*, Montr.).

♂. Nearly allied to *O. bambucina*: primaries velvet-black, becoming brown on the external border, the fringe at apex tipped with buff; veins almost wholly plumbaginous or sericeous bluish grey, an orbicular spot and discocellular crescent and an interno-median spot below the orbicular spot, all sericeous bluish grey: secondaries dark brown at base and on costa, changing to black from the middle of the wing, shot with blue; a moderately broad orange border occupying the external fifth of the wing. Body above black; collar, anal segment, and anal tuft orange. Primaries below greyish brown shot with steel-bluish, but less strongly between the veins towards outer margin; basal half of costal margin edged with buff; fringe as above: secondaries as above. Body below brown; front of pectus and anus orange; abdomen

* The following species may be described here:—

Ophthalmis Zelleri, sp. n.

♂. Size and colouring of *O. lincea*, but differing in the orange fringe of the primaries and the smaller apical patch on these wings, the inner edge of the said patch being rather concave than convex; the orange border of the secondaries as narrow as in *O. bambucina* from the Philippines. Expanse of wings 48 millim.

Ternate (coll. Zeller, in Brit. Mus.).

bluish, with pale brown lateral tufts and a few orange scales on the subterminal segment. Expanse of wings 50 millim.

Alu Island.

The absence of the well-marked ochreous apical patch on the primaries readily distinguishes this species from *O. bambucina.*

Zygænidæ.

HYALÆTHEA, gen. nov.

Nearest to *Trianeura* : primaries elongate-triangular; costal vein straight, reaching to apical fifth of costa; subcostal quadriramose, its first branch emitted at a considerable distance beyond the cell, the second and third branches forming a short fork to apex, the fourth branch (representing the upper radial) below the vein at about one third the distance from the cell to the outer margin; radial vein emitted from the upper third of the discocellular veinlet, which is angled outwards; second and third median branches emitted near together and at some distance from the first: secondaries very small, about one third the length of primaries; costal margin subangulated; outer margin very convex to the submedian vein, where it turns abruptly outwards to the internal vein, then inwards, returning in a semicircular curve to the base, the whole abdominal area forming a coarsely-scaled flap; costal vein absent; subcostal vein with a very short apical fork; discocellular veinlet inangled; radial absent; median branches well separated, more or less sinuous. Body similar to that of *Syntomis*; antennæ short, slightly spinous towards the tips.

4. *Hyalæthea Woodfordii*, sp. n.

Primaries purplish brown, almost black; the discoidal cell, a curved elongated stripe below it almost filling the internomedian interspace, an elongated elliptical streak or spot almost filling the last subcostal interspace, and two elongated spots almost filling the median interspaces, hyaline white: secondaries bright ochreous, with two small hyaline white spots on the median interspaces; costal border and fringe towards apex purplish brown. Vertex of head, antennæ, and thorax purplish brown; face, collar, tegulæ, and abdomen bright ochreous, the latter with four bands and the anal segment purplish brown; legs varied with brown. Expanse of wings 29 millim.

Alu.

5. *Euchromia gemmata*, sp. n.

Allied to *E. rubricollis*; wings above black-brown: primaries with the base and a small crescent at the end of the cell

brilliant metallic emerald-green; a cuneiform spot below the base of the median vein, a slightly oblique nearly central bifid patch cut by the median vein, a subcuneiform spot at base of last subcostal interspace, and a bifid almost cordiform patch cut by the third median branch hyaline white: secondaries with a trifid basal patch and an oblique discal patch cut by the subcostal and median veins hyaline white; a green crescent at the end of the cell, as in primaries. Head emerald-green with the face white; antennæ black; a white line on each side behind the eye; collar scarlet; shoulders ochreous, slightly opalescent; thorax and tegulæ black-brown, shot with emerald-green; abdomen with the basal segment ochreous, shot with opaline; remaining segments velvety black in front, metallic emerald-green behind, and ochreous changing to opaline at the sides. Wings below nearly as above. Pectus black-brown, oblique, streaked at the sides with pearly white; venter, with the exception of the last two segments (which are velvety black), orange, banded in front with black and bordered at the sides with scarlet. Expanse of wings 46 millim.

Alu.

This species differs from *E. rubricollis*, which we have from Aneiteum and Mallicollo, in the purer hyaline of the transparent wing-spots, the shorter basal spot, and less oblique central patch on primaries, the much more restricted hyaline basal area of secondaries, the more prominent ochreous shoulders, the completely ochreous basal segment of abdomen, the much greater width of metallic green on the abdominal segments, and the orange ventral surface of the abdomen. It is, in fact, a far more beautiful insect.

Arctiidæ.

6. *Areas semirosea*, sp. n.

♂. Nearest to *A. hyporhoda* of New Ireland &c.: primaries above ochreous; a black dot at base of costal area, a small black spot towards the base of interno-median area; three black spots in a straight transverse line from centre of inner margin, and a larger spot at the end of the cell: secondaries rose-red, with a large black spot at the end of the cell. Thorax ochreous, deepest in front; face and division of collar reddish; a red spot on each side in front of the collar; abdomen deep rose-red, with dorsal and lateral series of black spots. Under surface bright rosy vermilion; wings gradually shading into ochreous beyond the middle; each wing with a black spot at the end of the cell. Tibiæ and tarsi above greyish brown, below ochreous; venter with two series of black dots. Expanse of wings 48 millim.

Alu.

The males of this species and *A. hyporhoda* are readily separable from the males of *Spilarctia* by their slender antennæ.

Lithosiidæ.

Sphragidium, gen. nov.

Primaries oblong, triangular; costal margin of males bent forwards from end of cell, owing to a projecting flap overlapping the base of the subcostal branches; costal vein running close to the margin, with which it unites just before the end of the cell so as to thicken the costa in front of the flap; subcostal vein quadriramose, distorted, running beneath the thickened flap, where it becomes very weak, so that its continuity is scarcely traceable, emitting its first branch transversely, immediately beyond the flap, to costal margin, the three remaining branches running obliquely upwards to costa with a slight bend at their origins, the fourth branch terminating at apex; upper radial diverging from the subcostal branches, emitted beneath the flap from a scarcely perceptible discocellular veinlet; lower radial absent; second and third median branches emitted from the end of the cell and at some distance from the first branch, all three curving slightly upwards to outer margin; submedian vein extending from base to outer margin, internal vein from base to external angle: secondaries triangular, costal margin rather long, frenum very long, single; costal vein straight; subcostal forking a little more than halfway between the cell and outer margin; discocellulars equally inangled, the radial being emitted from their centre; second and third median branches forming a furca emitted from a long footstalk; first median branch emitted before the end of the cell; submedian and internal veins running from base to outer margin. Body robust, rather short; the thorax very convex; head wide; palpi short, rather smooth, closely scaled, apparently spinose in front; antennæ long, rather thick, with fine and very short ciliation; legs thick, rather long, the tibiæ of second pair of legs with a short, strong, terminal spine, those of hind pair with an additional subterminal spine.

Type *S. miles*.

To this genus *Dyphlœbia tricolora* and *D. liboria* must be referred; the genus *Dyphlœbia* being restricted to the African species, which have only two median branches in all their wings.

7. *Sphragidium miles*, sp. n.

Blue-black: primaries crossed by a broad brilliant scarlet

belt, with oblique or concave inner edge and angulated or convex outer edge, considerably broader in the female than in the male: secondaries of male black, with a rather broad central orange belt and white costal border; of female, orange, with the base and a tapering external border black; costal border white, as in the male. Thorax shot with steel-blue, collar below and anal tuft scarlet; central areas of wings below scarlet in front and bright ochreous (inclining to orange) behind. Expanse of wings, ♂ 33 millim., ♀ 34 millim.

Alu.

Nearest to *S. liboria* of Cramer, which we have from Amboina, Ceram, and New Britain.

8. *Miltochrista flavida*, sp. n.

Primaries pale buff; a black basal spot; base of costal margin, two convergent angulated stripes (the inner one at about basal fourth emitting a streak to base on internomedian interspace and united to the outer stripe just below the median vein), an arched discal stripe at external third, and almost confluent with a deeply trisinuate submarginal stripe, all dark grey: secondaries whitish buff. Head pale buff; collar pale buff, with a blackish spot on each side; tegulæ pale buff, with a black longitudinal dash; thorax dark grey; abdomen dull whitish, with pale buff anal tuft. Under surface uniformly pale stramineous; primaries with greyish indications of the markings of the upper surface. Expanse of wings 24 millim.

Alu.

Nearest to *M. senara* from Java.

9. *Miltochrista avernalis*, sp. n.

Primaries above dark grey-brown; a dot at base of costa, a subbasal spot, three angular bands (the first two interrupted below the middle), and three submarginal spots vermilion-red: secondaries grey, paler at base. Thorax vermilion, spotted with dark brown; abdomen grey, with basal and dorsal rose-red hairs, and anal extremity of the same colour. Primaries below suffused with rose-red at base; markings rose-red, more broken up into spots than above: secondaries darker than above, with the base and costa rose-reddish. Body below bright rose-red, posterior tarsi blackish. Expanse of wings 33 millim.

Alu.

A very beautiful species, not nearly allied to anything known to me; perhaps nearer to *M. fuscescens* of Mongolia

and China than anything else hitherto described. In pattern it is not unlike the species of *Nepita*.

10. *Katha fraterna*, sp. n.

Primaries flesh-coloured, with an ochreous subtint: secondaries rather dark buff-coloured. Head and collar sordid ochreous; antennæ blackish; shoulders ochraceous; thorax and tegulæ dark brownish grey; abdomen whity brown at base, ochraceous towards the anal extremity. Wings below stramineous, inclining to ochreous on the costal borders. Body below ochraceous. Expanse of wings 28 millim.

♂ ♀. Guadalcanar.

Curiously nearly allied to *K. intermixta* of South India, differing in its deeper coloration throughout, its blackish antennæ, and dark grey thorax and tegulæ; as nothing so closely allied seems to exist in the vast area separating the habitats of these two species, it is possible that in this instance the affinity may be more apparent than actual, being due to reversion.

Hypsinæ.

11. *Hypsa semifusca*, sp. n.

Allied to *H. heliconia*, from which it differs in having the external border of the secondaries extended inwards to the centre of the wing, the inner edge of the border being oblique and convex instead of concave in its wider portion; the creamy white basal area is also less pure in colour, especially towards the costa; the clavus of the median streak of primaries sometimes reduced to a mere thickening of the white extremity of the median vein. Expanse of wings 52–58 millim.

Alu (three specimens).

H. heliconia, of which we possess seven examples, is the form of *H. dana* occurring in Amboina; it differs chiefly from the latter in its more broadly black-banded abdomen and the slightly broader median streak of the primaries. Possibly these slight differences may prove to be inconstant in a larger series.

12. *Hypsa diana*, sp. n.

Allied to *H. australis* of New Guinea (Voy. de l'Astrolabe, pl. v. fig. 3), but differs as follows:—Primaries with the subbasal white patch reduced to a small sagittate spot; a small orbicular spot in the centre of the cell; a large white crescent, as in *H. australis*, but separated from the basal patch by nearly double the distance: secondaries and body of a more lively ochreous colour; the border of secondaries very broad

at costa, tapering to a point at anal angle and with undulated inner edge. Expanse of wings 66–79 millim.

Alu, Shortland Island, and Malayta (eleven examples in varying condition).

This species is absolutely constant in all the characters by which it is distinguished from the New-Guinea form; it belongs to the same group as *H. alienata*.

13. *Cleis nigrescens*, sp. n.

♂. Dark chocolate-brown; wings faintly shot with purple: primaries crossed just beyond the middle by a broad, oval, reddish-orange, oblique patch, not quite reaching the costa or external angle: secondaries with an internally diffused reddish crescent beyond the cell. Primaries below dark chocolate-brown, transversely mottled with bright scarlet; a bright ochreous patch representing the reddish-orange patch of the upperside, its outer edge bordered with black; external area bright scarlet, sprinkled with short black striæ and bounded by a blackish fringe on external margin: secondaries dark chocolate-brown; a nearly semicircular, internally diffused discal streak, followed by a black stripe and external border, as on the primaries. Body below ochraceous, the palpi and front of pectus reddish orange. Expanse of wings 33 millim.

Alu, Shortland Island.

Apparently a rare species; the female has the secondaries above immaculate, and on the under surface there is a complete submarginal series of silvery lilac spots.

14. *Cleis biplagiata*, sp. n.

♂. Chocolate-brown, with purplish reflections: primaries crossed beyond the middle by a broad, subpyriform, deep ochreous patch; face, palpi, antennæ, and sides of abdomen ochreous. Under surface bright ochreous: primaries with two black spots in the cell and an indistinct black line across the end of the cell: secondaries with a spot at the end of the cell; external borders red, striated sparsely with black, edged with black, and with indistinct, pearly whitish, submarginal spots; the under surface in fact principally differs from that of *C. versicolor* ('Reise der Novara,' Lep. Het. pl. cvii. fig. 24) in the absence of the central oblique black belt across the primaries. Expanse of wings 44 millim.

Ulaua.

Evidently rare and possibly, though not probably, an extreme variety of the following species.

15. *Cleis hypoleuca*, sp. n.

Allied to *C. versicolor*; dark purplish brown: primaries with a bright ochreous subpyriform patch, placed obliquely beyond the middle, the males also with a more or less prominent orange tapering submarginal streak, speckled with black: secondaries with a rather large bright ochreous spot, rounded in front, but with two notches out of its posterior edge. Face, palpi, antennæ, edge of collar, and margins of abdominal segments orange. Wings below almost as in the preceding species, but with a continuous series of pearly white submarginal spots. Expanse of wings, ♂ 35 millim., ♀ 30–36 millim.

Alu, Shortland Island (fourteen examples); ♀, Ulaua.

The females vary more than the males both in size and in the size of the ochreous patches on the wings.

Nyctemeridæ.

16. *Nyctemera aluensis*, sp. n.

♂ ♀. Nearly allied to *N. Herklotsii* and *N. baulus*, but differing from both in the decidedly wider white belt across the primaries, the outer edge of which is considerably more convex and the veins across which are always well defined; the discoidal and interno-median longitudinal white stripes on the primaries are always distinct, and in some examples of both sexes are so wide as entirely to alter the aspect of the insect; there can, however, be little doubt that these modifications are due to individual variation and are not specific characters. Expanse of wings 48 millim.

♂ ♀, Alu Island (four specimens); ♀, N.W. Bay, Malayta, 29th May, 1886.

Var. with wider longitudinal stripes on primaries.

♂ ♀, Alu Island (four specimens).

17. *Leptosoma sexmaculatum*, sp. n.

Allied to *L. luctuosum*, but with two large white patches on the disk of primaries in place of the white band of that species: primaries black, a large, nearly triangular, bifid white patch on basal area and two large patches, one above the other, beyond the middle, the upper one slightly impinging upon the discoidal cell: secondaries white, with black costal and external borders of the usual form and narrow blackish abdominal margin. Body of the usual type,

black; the margins of head, palpi, and collar narrowly ochreous; the tegulæ with narrow whitish edges; the abdomen banded above with white and below with ochreous. Expanse of wings 42 millim.

Alu.

18. *Pitasila disrupta*, sp. n.

Nearly allied to *P. selecta*, but differing in both sexes in having the oblique white belt of primaries oblique, divided into two parts by a stripe of the ground-colour on the first median interspace. Expanse of wings, ♂ 44 millim., ♀ 49 millim.

Alu.

Liparidæ.

19. *Artaxa inepta*, sp. n.

Allied to *A. Moorei*, part. (*Euproctis Moorei*, second figure, Snellen, Tijd. v. Ent. 1879, pl. viii.) *. Primaries, thorax, and antennæ bright ochreous; secondaries and abdomen ochreous whitish, quite white at costa; under surface wholly creamy whitish; primaries of male above with the basi-internal area, an internally zigzag central belt, which stops abruptly at upper radial vein and is bounded on both sides by a pale line and two spots beyond it, one on the median interspaces, the other close to inner margin, greyish brown; abdomen greyish behind, but with whitish anal tuft. Expanse of wings, ♂ 27 millim., ♀ 33 millim.

Alu.

This species is also allied to *A. anguligera* from N.W. India.

20. *Aloa cometaris*, sp. n.

Nearest to *A. terminata* of India, though in some respects more like the South-African *A. discalis*: primaries pale smoky greyish brown, with indistinct black markings, as in *Lymantria*: secondaries with the costal third excepting the border black; costal border and a broad longitudinal stripe tapering from outer margin to base and bounding the black area white; remainder of the wing dark greyish brown: body dark greyish brown. Primaries below whity brown,

* Herr Snellen is quite wrong in his supposition that the species of *Artaxa* are subject to extraordinary variation; his three figures represent certainly two, and possibly three, species.

the markings obsolete; secondaries nearly as above; body whity brown. Expanse of wings 43 millim.

Alu.

The antennæ of *Aloa* resemble those of *Lymantria*, the long pectinations being ciliated so as to give them a ragged feathery appearance.

Drepanulidæ.

21. *Callidrepana lunulata*, sp. n.

Stramineous: wings irrorated with shining scales, crossed towards the base by an irregular series of purplish-brown dots and lunules; a silvery white spot at the end of each discoidal cell, and a rather large blackish and silvery-centred brown spot at the base of the second and third median branches; an irregularly arched and angulated discal series of purplish-brown lunules and a submarginal series of short dashes: primaries with a blackish dot in the cell; costal margin brown at base, but becoming ochreous towards the apex; a rusty brownish cuneiform patch partly suffused with silver on outer margin at apex; anal half of abdomen white. Wings below pale shining stramineous; the markings of the upper surface faintly indicated here and there: body below white, with pale stramineous legs. Expanse of wings 38 millim.

Alu.

We have a specimen, apparently of this species, from Sumatra.

22. *Teldenia nivea*, sp. n.

Snow-white, wings crossed beyond the middle by an indistinct series of minute grey dashes; face and antennæ black; under surface without markings. Expanse of wings 25 millim.

Alu.

All the species of this singular little Geometriform genus hitherto described are white, and in all of them there is a discal angulated series of spots, lunules, or short dashes; the Ceylonese form, *T. alba*, is the most heavily marked, having not only a boldly defined discal series, but both submarginal and marginal spots. *T. vestigiata*, from Darjiling, has the discal series dark and sharply defined, but small, the submarginal series indistinct or obsolescent, the marginal series small but distinct, whereas in the present species an indication of the discal series alone remains.

In addition to the foregoing new species, there is in the

collection a remarkable modification (but whether locally constant or not there is at present no means of telling) of *Deiopeia pulchella*; in this form the black spots of primaries are run together into angulated macular stripes, the discoidal cell to the middle is greyish, and the black interrupted border of the secondaries is widened, so as to enclose the central marginal white spot. As in some varieties of *D. pulchella*, there is no spot or dash at the end of the cell. One example only was obtained at Alu.

XXX.—*Last Words on Professor Claus.* By E. Ray Lankester, M.A., LL.D., F.R.S.*

I have not the intention of following Prof. Claus in the use of offensive language, such as "sophistical falsification &c." At the same time I am anxious, before quitting this controversy, to say a few words, in order to demonstrate to the reader what the actual position is; and I shall leave to others the task of assigning the descriptive terms appropriate to Prof. Claus's conduct.

If the reader will be so good as to refer to my article of April 1886, in this Magazine, he will find that I there drew attention to the fact that Prof. Claus had published an article embodying certain views as to the classification of the Arthropoda which were identical with those expressed in a series of publications by myself, and that nevertheless Prof. Claus, although he had not previously given expression to these views and now published them as something "hitherto" unrecognized, yet omitted altogether to make any reference to my published statements on the subject.

I thought it right to point out and condemn this omission, the more so as I knew that Prof. Claus had previously been shown by other zoologists to have exhibited a want of discrimination in such matters.

I did not, of course, expect that Prof. Claus would confess the objectionable nature of his proceeding. He has contributed two articles on this subject to this magazine, in which a certain amount of ingenuity must be admitted; but, in spite of the efforts made by him, the candid reader who reviews the whole controversy will admit that Prof. Claus did actually

* [This discussion must now cease. The matters in dispute have been very fully ventilated, and our readers will be able to form their own conclusions. We may remark, however, that neither in the original nor in the abridged translation do we find all the "hithertos" which Prof. Lankester here inserts between inverted commas.—Eds. *Ann. & Mag. Nat. Hist.*]

and deliberately omit to cite and acknowledge the works of a predecessor which he ought to have cited and acknowledged, and that his articles in this magazine are, at the best, but lame excuses for a proceeding which is reprehensible.

When the facts stated by Prof. Claus are dissected out from the mass of misleading sneers and accusations with which he surrounds them, it is established:—

1st. That Prof. Claus, in his article in the 'Anzeiger' of the Vienna Academy, announced (*a*) as a "hitherto unrecognized" fact that the Acarina are degraded members of the class Arachnoidea; (*b*) that "hitherto" the Gigantostraca were regarded as Crustacea; (*c*) that "hitherto" an erroneous division of the Arthropoda into Branchiata and Tracheata had prevailed, which should be abandoned; (*d*) that "hitherto" it has been overlooked that the Hexapoda, Myriapoda, and *Peripatus* are united by the fact that they retain the prostomial antennæ found also in Chætopod worms, which are altogether absent in the Arachnida; (*e*) that "hitherto" a single origin had been assigned to tracheæ, whereas it was probable that they had originated independently in Arachnida and the other Tracheates.

2. That, contrary to the statements and pretensions of Professor Claus, these identical conclusions in their entirety and as related one to another had been previously formulated by me as the result of special studies, and published several years (1881) before the date of Prof. Claus's communication to the Vienna Academy (1886).

3. That the fundamental theory of a backward movement of the oral aperture in the Crustacea, and the consequent relative forward movement of primarily postoral appendages, so as to become secondarily præoral, was published by me in 1873 and adopted by Claus in 1876, who *added nothing to the facts as to nerve-supply* in relation to this matter, already established by Zaddach.

Professor Claus has endeavoured to justify himself by declaring that some of these views may be read between the lines here and there in his 'Grundzüge' and in his 'Crustaceensystem.' On the other hand, it is not possible for him to deny that the prominent and explicit statements on these points made in those publications are *contrary* to the views enunciated in his note in the Vienna 'Anzeiger,' and that were this not so he could not have brought these views before the Academy as novelties.

Whether the suggestion of such views may be obscurely visible in some isolated passages of Prof. Claus's previous writings or not, is not a matter which has any bearing on the

charge which I make against Prof. Claus. What I complain of is that he stated to the Vienna Academy that "hitherto" *other* views were held by zoologists, and that the views then announced by him were *novelties.* As a matter of fact they were not novel, but had been in so many words and in identical terms formulated by me five years before, and published as a special essay in a journal habitually studied by Prof. Claus. Moreover, these views were not obscurely hinted at by me in scattered passages of a treatise definitely supporting other and antagonistic views, but were all enunciated in logical sequence and made the subject of special discussion and investigation in the essay alluded to, "*Limulus* an Arachnid." This publication Professor Claus chooses to ignore in claiming novelty for the views published by him in the 'Anzeiger' five years after its appearance.

I leave the reader to classify the conduct of Prof. Claus in thus dealing with the published work of his contemporaries.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

January 27, 1886.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communications were read:—

1. "On the Fossil Mammalia of Maragha, in North-western Persia." By R. Lydekker, Esq., B.A., F.G.S., &c.

The Author alluded to the important memoirs of Messrs. Grewingk, Pohlig, and Rodler on the Maragha Mammalia, and having expressed the hope that his notice would be regarded as an attempt to assist rather than to interfere with their work, mentioned a collection of specimens from Maragha sent by Mr. Damon to the British Museum. He fully confirmed the conclusions already arrived at as to the identity of many of the Maragha mammals with those of Pikermi, and thought that *Giraffa attica*, *Palæoryx Pallasi*, *Sus erymanthius*, *Mastodon pentelici*, and *Helladotherium Duvernoyi* might be added to the list of species already recorded. He also recorded the French *Felis brevirostris*; a *Rhinoceros*, apparently allied to *R. antiquitatis*; and *R. Blanfordi*, of the north-west portion of India and China. The paper concluded with some observations regarding the relations of the Palæarctic and Oriental Pliocene faunas.

2. "On the Pliocene of Maragha, Persia, and its resemblance to that of Pikermi, in Greece; on Fossil Elephant-remains of Caucasia and Persia; and on the results of a Monograph of the Fossil Elephants of Germany and Italy." By Dr. H. Pohlig. Communicated by Dr. G. J. Hinde, F.G.S.

The principal object of the Author in making a geological tour

through part of Persia, in 1884, was the exploration of a deposit containing Pliocene mammals, discovered thirty years ago near Maragha, east of Lake Urumia, by Göbel and Khanikoff. The first part of the present paper gives a brief account of the results of this exploration, together with a list of the fossils.

The ossiferous deposits near Maragha are of fluvio-lacustrine origin, and consist chiefly of reddish marls, similar to those of Pikermi, and formed from the detritus of the volcanic mountain of Sahend. These Pliocene beds rest upon horizontal Cretaceous strata, and pass upwards into Pleistocene deposits with erratic blocks.

In the list of fossil Mammalia it is shown that several are the same as Pikermi forms. A *Hipparion*, probably identical with *H. gracile*, is the most abundant. The supposed occurrence of Pleistocene forms, such as *Rhinoceros tichorhinus*, associated with the Maragha Pliocene fossils, is probably an error.

The second part of the paper contains notes on specimens of *Elephas primigenius*, chiefly in the Museum of Tiflis. The third part gives very briefly the principal results of the Author's examination of Pleistocene Proboscidea in the various museums of Europe, especially in those of Germany and Italy, and concludes with his views with respect to *Elephas antiquus*, *E. melitæ* (which he considers a dwarf form of *E. antiquus*), *E. meridionalis*, *E. hysudricus* (which the Author considers identical with *E. meridionalis*), *E. primigenius*, and a few other species, one of which is believed to be new.

February 10, 1886.—Prof. T. G. Bonney, D.Sc., LL.D., F.R.S., President, in the Chair.

The following communication was read:—

"On a new Species of *Psilotites* from the Lanarkshire Coal-field." By R. Kidston, Esq., F.G.S.

The specimen described, which was found by Mr. Walter Burns in 1884, consists of three parallel branchlets with thorn-like projections on one side only. The Author describes these as a form of Goldenberg's genus *Psilotites*, and points out that they have much resemblance to Dawson's *Psilophyton*.

March 24, 1886.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communication was read:—

"On the Genus *Diphyphyllum*, Lonsdale." By James Thomson, Esq., F.G.S.

The Author commenced by giving a definition of the genus *Diphyphyllum*, and then proceeded to discuss its relations with some allied forms, such as *Lithostrotion*, *Lithodendron*, and *Campophyllum*. *Diphyphyllum* was shown to be restricted in Scotland to the lower portion of the Carboniferous system, and not to have survived the great development of volcanic action in the upper part of the

Carboniferous-Limestone series, whereas in Belgium and elsewhere the range of this genus was more extensive.

It was shown that in *Diphyphyllum* reproduction took place both by fissiparity and by calicular gemmation, examples of both forms being cited. It was also pointed out that the development of central vertical plates, showing a tendency to a passage into *Lithostrotion*, was due to the corals having lived in a sea periodically affected by the influx of sediment from the neighbouring shore.

After a history of the views held by different writers since Lonsdale, and especially by M^cCoy, Milne-Edwards and Haime, Hall, Billings, and De Koninck, on corals referred to this generic type, the author gave a description of the species found in North Britain; and after pointing out their differences, showed that all exhibit a tendency to vary, and that, if a sufficient series were available, a passage might be traced not only between the different species, but between *Diphyphyllum* and the various allied genera.

April 7, 1886.—Prof. J. W. Judd, F.R.S.,
President, in the Chair.

The following communications were read:—

1. "On a Lower Jaw of *Machærodus* from the "Forest-bed," Kessingland." By James Backhouse, Esq., F.G.S.

The Author believed that hitherto no example of a lower jaw of *Machærodus* has been met with in this country; he consequently gave a detailed description and measurements of a right mandibular ramus obtained by him from the Forest-bed at Kessingland, in Suffolk. Owing to the imperfect condition of the incisors and canines, it was impossible to say whether these teeth were serrulated or not, and consequently it was uncertain whether the bone belonged to *Machærodus cultridens* or *M. latidens*.

2. "A Contribution to the History of the Cetacea of the Norfolk "Forest-bed."" By E. Tulley Newton, Esq., F.G.S.

This paper was principally devoted to the description of two fossil specimens. The first of these was a tooth, shown by external and microscopical characters to have belonged in all probability to the Sperm-whale, *Physeter macrocephalus*. The specimen was obtained by Mr. Clement Reid, at Sidestrand. The second fossil, also from Sidestrand, and now in the possession of Mr. James Backhouse, consisted of the right half of the seven anchylosed cervical vertebræ of a species of *Balæna*. The specific determination was less certain in this case; but the form approached most nearly to that of *B. biscayensis*. Of other vertebræ from the Forest-bed, one, a caudal, was referred to *Balæna*; another, from the lumbar region, to *Balænoptera*.

May 12, 1886.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communications were read:—

1. "On the Maxilla of *Iguanodon.*" By J. W. Hulke, Esq., F.R.S., F.G.S.

Two fragments, together representing nearly the entire left maxilla of a species of *Iguanodon*, have been found at Cuckfield, the locality whence the first tooth of the genus was obtained by Dr. Mantell, about 1820. These fragments, measuring together 29 centimetres, and exhibiting 19 alveoli in the dentary border, were described in the paper. It was shown that the upper jaw in question probably belonged to *Iguanodon Mantelli.* In addition to the detailed characters described, the maxillæ of *Iguanodon* and *Hypsilophodon* were compared, and their distinctions explained.

2. "Notes on the Distribution of the Ostracoda of the Carboniferous Formations of the British Isles." By Prof. T. Rupert Jones, F.R.S., F.G.S., and J. W. Kirkby, Esq.

Although all the Ostracoda of the Carboniferous Formations are not yet described, there are 170 species and notable varieties known, belonging to 33 genera of 9 families. About 25 of these species, not yet described, but determined by the Authors, are introduced into their lists as giving a fuller idea of the value of this manifold Crustacean group.

In the first place they referred to the classification of the Carboniferous strata in Scotland and in England, according to the local differences, taking in succession "Scotland West," "Scotland East," "England North, with the Isle of Man," "England Central and South, with South Wales," as the several districts from which they have obtained good groups of Ostracoda from different members of the Carboniferous series.

In Fife, the lowest local Carboniferous strata contain *Beyrichia subarcuata*; higher up come in *Carbonia fabulina*, *C. Rankiniana*, *Bairdia nitida*, and *Leperditia Okeni*; the last, accompanied by other species, occurs throughout this lowest series, in which the record is more complete than in Midlothian and Linlithgowshire, where the same species also occur. In Dumfriesshire and Ayrshire *Leperditia Okeni* and *L. subrecta* have been found in beds even lower than those above mentioned, and are therefore probably the oldest Carboniferous Ostracoda; other species accompany them higher up, and in Roxburghshire some localities of the Calciferous-Sandstone series are very rich in species. The Carboniferous-Limestone series of S.W. Scotland has been highly productive of Ostracoda, particularly the shales of the lower beds; 36 species are common or characteristic. The middle or coal-bearing portion has yielded but few, chiefly *Leperditia Youngiana*, one *Beyrichia*, *Carbonia fabulina*, and *C. Rankiniana.* The Upper-Limestone group contains many recurrents from below and a few others, including *Youngia rectidorsalis.*

The Millstone-Grit equivalents have no Ostracoda; but the overlying Coal-measures are rich in *Carboniæ*, with a few others, such as *Cypridina radiata*.

A great variety of genera and species come from beds at or near the base of the Scar Limestone and its equivalents in North Lancashire, Westmoreland, Cumberland, and Northumberland. The calcareous shales of the Yoredale series have several interesting forms, including *Phreatura concinna*; none from the Millstone-Grit.

The Lower Coal-measures give *Beyrichia arcuata* and *Carbonia*, sp. The middle beds have *B. arcuata* and *Carbonia fabulina*, common; rarer, *C. Rankiniana*, *C. secans*, *C. scalpellus*, *C. Wardiana*, and *Philomedes elongata*. In the Upper Coal-measures *B. subarcuata* reappears; and in the *Spirorbis*-limestone *Leperditia inflata* is the latest Carboniferous Ostracod in England.

In Northamptonshire the deep Gayton boring (at 730 feet) has given *Kirkbya variabilis*, *K. plicata*, *Bythocypris sublunata*, *Macrocypris Jonesiana*, *Cytherella extuberata*, and *C. attenuata*, all but one belonging to the Lower-Carboniferous series. In Salop, South Wales, and Somerset the Carboniferous Limestone has yielded several good species of *Leperditia*, *Kirkbya*, *Moorea*, *Bythocypris*, *Bairdia*, &c. *Carbonia Agnes* and *C. Evelinæ* belong to the South-Welsh Coal-measures.

The distribution of the Carboniferous Ostracoda in Ireland requires further work; but the Lower-Carboniferous Shales and the Mountain Limestone near Cork and elsewhere are very rich, as are also some parts of the latter in the Isle of Man.

The Ostracoda of the Permian Formation were then treated of in relation to their Carboniferous allies, and the range of the British Carboniferous Ostracods in Europe and North America was noticed in some detail.

The results of the examination were shown in two extensive tables.

3. "Note on some Vertebrata of the Red Crag." By R. Lydekker, Esq., F.G.S.

This communication contained briefly the results of a reexamination of the specimens from the bone-bed of the Red Crag in the British and Ipswich Museums, a series of casts from the latter having been added to the former. The forms noticed were *Hyæna striata*, with which *H. antiqua* and *H. arvernensis* were considered probably identical; *Mastodon*, of which the author thought three species, *M. arvernensis*, *M. longirostris*, and *M. Borsoni* were represented; *Sus*, of which two forms, the larger probably *S. erymanthius* or *S. antiquus*, the smaller *S. palæochœrus*, had been detected; a Tapir, which was probably *Tapirus arvernensis* or *T. elegans* rather than *T. priscus*; *Hipparion gracile*; a *Rhinoceros* referable to the hornless *R. incisivus* rather than to *R. Schleiermacheri*, though the latter probably also occurred; and a species of Albatross (*Diomedea*), represented by a right tarso-metatarsus, and the associated proximal phalangeal bone of the fourth digit.

June 23, 1886.—Prof. J. W. Judd, F.R.S.,
President, in the Chair.

The following communications were read:—

1. "On the Decapod Crustaceans of the Oxford Clay." By James Carter, Esq., F.G.S., &c.

The Author commented on the paucity of these fossils as indicated in British lists, only three or four species having hitherto been recorded.

The discovery of considerable numbers of Decapod Crustaceans in the Oxford Clay of St. Ives has enabled the Author to increase the list materially. Many have been collected by Mr. George, of Northampton. These fossils occur in the clay immediately beneath the St. Ives rock, and therefore presumably in the uppermost zone of the Oxford Clay. Many of the specimens are more or less mutilated, but some fifteen or sixteen distinct species have been made out. None of these have been recorded as British except *Eryma Babeaui*, mentioned by Mr. Etheridge as having been found in the Kimmeridge Clay. Seven species are identified as foreign forms, and seven are new to science. They are distributed as follows:—

Eryon	1	species.
Eryma	5 or 6	,,
Glyphea	2	,,
Magila	2 or 3	,,
Mecochirus	2	,,
Goniochirus	1	,,
Undetermined	3	,,

Nearly all the forms belong to the type of the Macrura, the Brachyura being doubtfully, if at all, represented.

2. "On a new Emydine Chelonian from the Pliocene of India." By R. Lydekker, Esq., B.A., F.G.S.

The Author described the shell of an Emydine Tortoise from the Siwaliks of Perim Island, Gulf of Cambay, which he regarded as decidedly distinct from any of the previously-described Siwalik species, and proposed to refer to the genus *Clemmys*, with the name of *C. Watsoni*, in compliment to the donor of the specimen.

November 3, 1886.—Prof. J. W. Judd, F.R.S.,
President, in the Chair.

The following communications were read:—

1. "On the Skull and Dentition of a Triassic Saurian, *Galesaurus planiceps*, Ow." By Sir Richard Owen, K.C.B., F.R.S., F.G.S., &c.

The Author referred to a fossil skull from the Triassic sandstone of South Africa, which combined dental characters resembling those of a carnivorous Mammal with the cranial structure of a Saurian. The structure was described and figured in Owen's 'Catalogue of the Fossil Reptilia of S. Africa,' under the generic title of *Gale-*

saurus, as belonging to a distinct suborder of Reptilia, termed *Theriodontia*.

The characters of the skull and teeth of the original specimen of *Galesaurus* have been brought to light by further development.

In both the type specimen and that lately received the reptilian nature of the fossil is indicated by the single occipital condyle and other features. The chief difference from a mature male of a placental or marsupial carnivore is the evidence of a primordial "gullet-tract." Further details as to the structure of the skull were given, more especially with reference to the orbits and nasals. The palatal region repeats the same general characters as in previously described Theriodonts. The angle of the jaw is not produced, as in the crocodile, beyond the articular element. In general shape and bony strength the mandible of *Galesaurus* resembles that of a mammal.

The dentition is so much better preserved in the new specimen than in the type Galesaur as to call for description and illustration. In four of the upper molars the entire crown is preserved; it shows less length and greater breadth than appears in the previous restoration, is moderately curved externally, and triangular; the base is flanked by a short cusp before and behind, and the corresponding margins are finely crenulate, as in the molars of *Cynodraco*. The incisors are eight in number in both upper and lower jaws, four in each premaxillary, opposed or partially interlocking with the same number in each mandibular ramus; they have longish, slender, simple-pointed crowns. The canines, one on each side of both upper and lower jaws, have the same laniariform shape and size of crown as in the original fossil. In the right maxillary bone the long deeply planted root is exposed; the corresponding part of the lower canine is similarly exposed in the left mandibular ramus. No trace of successional teeth, as in ordinary Saurians, has been found.

Both Crocodiles and Alligators have two or more teeth of canine proportions; but the Author shows how they differ from those of mammalian carnivores and *Galesaurus*. A similar character and disposition of destructive canines is shown by the fossil jaws of the oolitic great extinct carnivorous Saurians, e. g. *Megalosaurus*. In the Triassic Labyrinthodonts the destructive and prehensile laniaries would by position rank as incisors rather than canines. In existing Lizards the dental series has more uniformity, and the cement-clad roots contract bony union with the jaw-bone. In *Galesaurus* the teeth, besides being distinguished, as in Mammals, by their differential characters, are implanted freely in sockets, the cold-blooded character being chiefly manifested in the greater number of teeth following the canines, and in their want of distinction.

Lastly the Author remarked on the earlier reptilian character shown by the oolitic Mammal *Amphitherium*, and also by the existing Australian *Myrmecobius*. He speculated on the degree of resemblance manifested by the teeth of the old Triassic Reptile of South Africa with the exceptional characters of some of the low Australian forms of Mammals.

2. "The Cetacea of the Suffolk Crag." By R. Lydekker, Esq., B.A., F.G.S., &c.

This paper commenced with notices of previous contributions to the subject by Sir R. Owen, Prof. Ray Lankester, Prof. Huxley, and Prof. Flower. In the preparation of a catalogue of the specimens in the British Museum, the Author had had occasion to examine the collection of Cetacea from the Crag, not only in that Museum, but also in the Museum of Practical Geology, that of the Royal College of Surgeons, and in the Ipswich Museum, besides visiting the collections at Brussels. In consequence several additions to the fauna and also numerous emendations of specific names were noticed in the paper now laid before the Society. Prof. Ray Lankester's views as to the Diestian affinities of the English-Crag Cetacea were confirmed by this comparison.

Detailed notes on the specimens examined and the species identified were given. The following list of the species believed to be represented in the various collections mentioned was given at the conclusion of the paper :—

BALÆNIDÆ.

Balæna affinis, *Owen.*
—— primigenia, *van Beneden.*
—— insignis (*van Beneden*).
—— balænopsis (*van Beneden*).
Megaptera affinis, *van Beneden.*
—— similis (*van Beneden*).
—— minutus (*van Beneden*).
Balænoptera definita (*Owen*).
—— Goropi, *van Beneden.*
Balænoptera borealina, *van Beneden.*
—— emarginata (*Owen*).
Cetotherium Brialmonti (*van Beneden*).
—— dubium (*van Beneden*).
—— Hupschi (*van Beneden*).
—— brevifrons (*van Beneden*).
Herpetocetus scaldiensis (*van Beneden*).

PHYSETERIDÆ.

Eucetus amblyodon, *du Bus.*
Homocetus Villersi, *du Bus.*
Balænodon physaloides, *Owen.*
Physodon grandis (*du Bus*).
—— fusiformis ? (*du Bus*).
Hoplocetus crassidens, *Gervais.*
—— borgehoutensis, *Gervais.*
—— crassidens ?, *Gervais.*
Hyperoodon, sp.
Choneziphius planirostris (*Cuvier*).
Choneziphius planus (*Owen*).
—— Packardi, *Lankester.*
Mesoplodon longirostris (*Cuvier*).
—— tenuirostris (*Owen*).
—— gibbus (*Owen*).
—— angustus (*Owen*).
—— angulatus (*Owen*).
—— compressus (*Huxley*).
—— Floweri, *Canham, MS.*

SQUALODONTIDÆ.

Squalodon antverpiensis, *van Beneden.*

DELPHINIDÆ.

Orca citoniensis, *Capellini.*
Globicephalus uncidens (*Lankester*).
Delphinoid genus, non det.

3. "On a Jaw of *Hyotherium* from the Pliocene of India." By R. Lydekker, Esq., B.A., F.G.S., &c.

Colonel Watson, the Political Resident in Kattiawar, had recently sent to the Author a fragment of a left maxilla with the three true molars from Perim Island, in the Gulf of Cambay. The specimen belonged to *Hyotherium*, and apparently to an undescribed species,

the differences between which and the several forms previously known from various European and Asiatic beds were pointed out. The Author also called attention to the peculiar association of types found in the beds of Perim Island, and to the affinities of the genus *Hyotherium* with the recent *Sus* and *Dicotyles* on the one hand, and with the Upper Eocene *Chœropotamus* on the other.

December 1, 1886.—Prof. J. W. Judd, F.R.S.,
President, in the Chair.

The following communications were read :—

1. "On a new Genus of Madreporaria—*Glyphastræa*, with remarks on the *Glyphastræa Forbesi*, Edw. & H., sp., from the Tertiaries of Maryland, U.S." By Prof. P. Martin Duncan, M.B., F.R.S., F.G.S., &c.

The specimens of *Septastræa Forbesi*, Edw. & H., were examined many years ago, and the Author had always a doubt about their generic position. Lately a very well-preserved specimen has been received, which when compared with those in the National Collection and carefully studied, is found to have a columella and a remarkable dome of endotheca at the top of the base of the calicular fossa, resembling the well-known structure in *Clisiophyllum*.

Two opposite primary septa become very narrow, extend inwards, form, with another structure, a narrow linear columella, and thus produce the appearance of a continuous lamella. The other primaries and some of the secondary septa reach this long structure, and the endotheca stretches between the ends of the septa, their sides, and the columella, and closes up the interseptal loculi. The epithecal dissepiments are dome-shaped at the base of the calice, and are ornamented with sparsely distributed granules: superficially a corresponding granulation occurs on the narrow and also on the wide marginal parts of the septa.

There is a groove between the calices, and it corresponds with the imperfect junction of the corallite walls. Fissiparity occurs and also gemmation.

Natural sections show a narrow ribbon-shaped columella.

The examination of the perfect specimens proves that whilst they cannot be understood without sections, sections alone would never enable the palæontologist to realize the elaborate superficial structures. It was pointed out that weathering utterly destroyed the generic and specific characters, and the Author ventured to caution the students of the Madreporaria against describing weathered and worn specimens of any types, and not to depend entirely upon sections.

The new genus *Glyphastræa* includes Astræidæ of the Goniastræoid alliance with fissiparity, gemmation, and a ribbon-shaped columella. *Septastræa Forbesi* becomes *Glyptastræa Forbesi*, Edw. & H., sp.

2. "On Fossil Chilostomatous Bryozoa from New Zealand." By Arthur Wm. Waters, Esq., F.G.S.

The fossil Bryozoa described in the present paper are from the localities of Petane, Waipukurau, Wanganui, and some simply designated as from the neighbourhood of Napier. The first three represent deposits of a well-known position, which was considered Miocene by Tenison-Woods, but which Professor Hutton (Quart. Journ. Geol. Soc. vol. xli.) has more recently called Pliocene. Some others, sent over as from "Whakati," are thought to be from Waikato.

The genus *Membranipora*, which is largely represented from near Napier, is not one of the most useful palæontologically, because the shape of the opesial opening only, and not the oral, is preserved, and also the appearance of the zoœcia is often remarkably modified by the ovicells, which, however, are frequently wanting, and in many well-known species have never been found.

The Author pointed out that in the commoner and best-known species of Bryozoa the amount of variation is recognized as being very great, and considered that in the face of this there is too great a tendency to make new species on slight differences which may be local variations, and that even in some cases instead of the description referring to a species, it may be that only a specimen has been described.

A list of New-Zealand Bryozoa has been drawn up by Professor Hutton, and our knowledge of the New-Zealand and Australian Bryozoa is being constantly increased by MacGillivray, Hincks, and others; nevertheless enough is not yet known to fix the exact age by means of the Bryozoa alone, but the large number of species entirely identical with those living in the neighbouring seas, and the general character of the others, show that the deposits must certainly be considered as of comparatively recent date.

Out of the 78 species or varieties, 61 are known living, 29 of these from New-Zealand seas, 48 from either New-Zealand or Australian waters, and 28 have been found fossil in Australia. Judging from these alone, it would seem that some authors have assigned too remote an age to the deposits. The new forms described were:—

Membranipora occultata.
Monoporella capensis, var. dentata.
—— waipukurensis.
Micropora variperforata.
Mucronella tricuspis, var. waipukurensis.
—— ——, var. minima.
—— firmata.
Porina grandipora.
Lepralia semiluna, var. simplex.
—— bistata.
Schizoporella cinctipora, var. personata.
—— tuberosa, var. angustata.
Cellepora decepta.
——, sp.

December 15, 1886.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communications were read:—

1. "Notes on *Nummulites elegans*, Sow., and other English Nummulites." By Prof. T. Rupert Jones, F.R.S., F.G.S.

The Author finds in the "Sowerby Collection," now in the British

Museum, the original specimens on which Sowerby founded his *Nummularia elegans* (1826, Min. Conch. vol. vi. p. 76). These are partly specimens from that part of the bed "no. 29" of Prof. Prestwich's section of Alum Bay (Quart. Journ. Geol. Soc. vol. ii. (1846) p. 257, pl. ix. fig. 1) which is known to be the lowest of the Barton series, and partly some in a stone said to be from Emsworth, in Hampshire. The former are the same as those named *Nummulites planulata*, var. *Prestwichiana*, by Rupert Jones in 1852; and the latter are *N. planulata*, Lamarck (1804), and probably foreign. Thus *N. elegans* has priority over *Prestwichiana*; and as this last was determined by De la Harpe to be a variety of *N. wemmelensis*, Van den Broeck and De la Harpe, this variety should be var. *elegans*. The Author thinks that, on broad zoological principles, *N. planulata* might still be regarded as the species; but, in view of the careful differentiation worked out by De la Harpe, he accepts the "specific" standing of "*wemmelensis*" as useful among *Nummulites*; but "*Prestwichiana*" has to give way to "*elegans*" for the peculiar "Barton" variety. A bibliographical history of the long-misunderstood *N. elegans*, Sowerby, descriptions of this form and of *N. variolaria* (Lam.), notes on *N. lævigata* (Brug.), and an account of their range in England completed the paper.

2. "On the Dentition and Affinities of the Selachian Genus *Ptychodus*, Agassiz." By A. Smith Woodward, Esq., F.G.S.

The genus *Ptychodus*, owing to the detached condition in which the teeth are usually found, has hitherto been imperfectly understood. Agassiz referred it to the Cestraciontidæ on account of a supposed resemblance in the arrangement of the teeth, and Owen's researches on their microscopic structure served to confirm this view. On the other hand, several writers have pointed out characters tending to show affinity between *Ptychodus* and *Rhynchobatus*.

More recently, however, Prof. Cope and the Author had shown that the supposed affinities between *Ptychodus* and the Cestraciontidæ were only apparent, and in the present paper additional evidence was brought forward.

The Author proceeded to describe several specimens of *P. decurrens* in the British Museum, and in the collection of Mr. H. Willett, of Brighton, one of the latter, especially, containing, what had been previously entirely unknown, the dentition in part of both jaws. These specimens showed that each jaw contained six or seven longitudinal rows of teeth on each side of the median row, and that the genus must be referred to the true Rays and not to the Cestraciont Sharks, though the precise family to which *Ptychodus* belongs was more difficult to determine. On the whole the writer was disposed to assign it a place either amongst the Myliobatidæ or in their neighbourhood. The microscopic structure of the teeth was shown to be insufficient, by itself, to show their affinities.

3. "On a Molar of a Pliocene type of *Equus* from Nubia." By R. Lydekker, Esq., B.A., F.G.S.

A small collection of Mammalian remains from near Wadi Halfa had recently been placed in the Author's hands; some of the bones were mineralized similarly to those of the Upper Pliocene of the Val d'Arno, or the Lower Pleistocene of the Narbadá valley. Amongst others the most interesting is a right upper cheek-tooth of *Equus* but little worn. It evidently does not belong to any of the late Pleistocene or Recent species of the genus, but to the more generalized group comprising *E. sivalensis*, &c.; though, bearing in mind the impossibility of distinguishing many of the existing species of the genus by their teeth alone, its absolute specific identity is not asserted. We may infer, then, that the ossiferous beds of Wadi Halfa are not improbably of Pliocene age, since this group of Horses, both in Europe, Algeria, and India, had totally disappeared after the period of the Forest-bed. Moreover, it is of interest, in view of previously expressed opinion, to find in the Tertiary of Nubia a species of this primitive group of *Equus* which is apparently more nearly allied to the Siwalik than to the European species.

January 12, 1887.—Prof. J. W. Judd, F.R.S., President, in the Chair.

The following communications were read:—

1. "The Ardtun Leaf-beds." By J. Starkie Gardner, Esq., F.G.S., F.L.S.; with Notes by Grenville A. J. Cole, Esq., F.G.S.

The description of these beds by the Duke of Argyll thirty-five years ago indicated that enormous tracts of Trap in the Inner Hebrides were of Tertiary age. Prof. Edward Forbes, who described the leaves, inclined to the idea that they might be Miocene; but in estimating the value of this conjecture, we must remember that at the time the existence of Dicotyledonous leaves of similar aspect, but of undoubtedly Cretaceous age, was quite unsuspected, and that no typical Eocene flora had then been properly investigated or described. Prof. Heer, however, adopted the opinion that the age of this formation was Miocene, and unfortunately extended its application to formations containing similar floras in Greenland and elsewhere. One object of the present communication is to show that, instead of belonging to the Miocene, these floras are of Eocene age, and in fact older than the Thanet beds. The other object is to redescribe the plant-beds, and to show that they are part of a rather extensive series of sedimentary rocks intercalated among the Traps.

The rapid accumulation of knowledge as to the distinguishing characteristics of Cretaceous, Eocene, and Miocene floras has rendered the attainment of the former object at least possible, and it is of the greater importance, since the error in determining the age of the fossil floras of Ardtun and Antrim, and of a part of the Arctic flora,

is a great impediment to further progress. Instead of all these immense thicknesses of beds belonging to the Miocene, they have their base somewhere in the so-called Cretaceous series; 400 feet higher up we are about the horizon of the Thanet Beds; while at 1000 feet up the flows were contemporaneous with the Bracklesham and Barton deposits. The first acid eruptions were Miocene, as shown by the floras preserved in Iceland.

The Author described the various exposures from his own observations and Mr. Cole's notes. At Ardtun the Traps are surmised to be parts of once continuous flows, still represented at Staffa and Burgh, but broken through by an intrusive sheet. The leaf-beds are varied in composition, the richest being very friable, while the best matrix is a limestone as fine as lithographic stone, in which plant-remains are few, but exquisitely preserved. They are overlain by thick deposits of river-gravel, chiefly composed of flint or silicified chalk, but in which Mr. Cole has detected fragments of sanidine like that of Ischia or the Rhine, and of trachyte. At Carsaig the gravels are coarser and less evenly bedded, and the sandy matrix apparently is entirely made up of flint. The coarse gravels are flanked by sands and indicate a rapid flow of water, occupying a valley not less than a mile across. The Ardtun gravels indicate a less rapid but more extensive river. The section at Burgh is very like that at Ardtun, with the addition of an extensive ash-bed at the base, with sand instead of gravel, and with many hundred feet of Trap above. In the Wilderness there is a small outcrop of Chalk-rubble, less than 300 square feet in extent, and evidently redeposited. Some distance under this is Greensand *in situ*, then Lower Lias, and lastly Poikilitic sands. This descriptive part of the paper concluded with some remarks on the estuarine formation between the Chalk and Upper Greensand at Beinn Jadain in Morven, which the Author investigated in the hope of finding plant-remains belonging to that interesting age. He doubts that the Chalk is *in situ*, and considers the evidence of age to be not quite conclusive.

The second part of the paper dealt with the Palæontological evidence. The evidence, if confined to the plants of Ardtun, was said to be scarcely worth serious discussion, and the analysis was extended to the far richer plant-bed at Atanekerdluk. The identifications of these with Miocene plants of Europe were discussed *seriatim*, and shown to be groundless, or only applied to such prevailing types of leaves as are common to widely distinct genera, and occur in floras recent as well as fossil, and which cannot be superficially distinguished in even a living state. The strong resemblance and even identity of the best-characterized forms with the older Eocene plants has been, on the other hand, hitherto ignored. The most strongly marked types of Greenland, and which recur in Antrim, are met with in the Heersian of Gelinden and at no other horizon, and amply suffice to fix the date of the Antrim floras. The Mull flora, as its aspect indicates, is still older, and consequently earlier than the Thanet Beds of England. Independently of positive evidence, the absence of any late Tertiary types, even of the Legu-

minosæ, which abound as low down as the Reading Beds, sufficiently indicates their extreme antiquity.

2. "On the Echinoidea of the Cretaceous Strata of the Lower Narbadá Region." By Prof. P. Martin Duncan, M.B., F.R.S., F.G.S.

A collection of fossils from the limestone near Bág, in Western India, made by Colonel Keatinge, was described by the Author in the Quarterly Journal of the Society for 1865, and shown to be of Upper Greensand or Cenomanian age. The country was subsequently examined, and a sketch-map made by Messrs. Blanford and Wynne, who found near Bág the following beds in descending order beneath the Deccan and Malwa traps:—

Coralline limestone.
Argillaceous limestone.
Nodular limestone.
Sandstone.

All were conformable, the whole thickness of limestone did not exceed 50 feet, and the fossils obtained by Colonel Keatinge were shown to have been exclusively derived from the Argillaceous limestone. All the beds were referred to the same Cretaceous subdivision.

Good topographical maps having been prepared, the area was remapped by Mr. Bose, who obtained several additional fossils from the Coralline and Nodular limestones, and a few from the upper beds of the sandstone. He accepted the Cenomanian age for the Argillaceous limestone, but referred the overlying Coralline limestone to a Senonian age, and the underlying Nodular bed to the Gault, whilst he regarded the sandstone at the base as probably Neocomian.

Mr. Medlicott, Director of the Geological Survey of India, in compliance with the author's request, had sent to him the Echinoidea collected by all the geologists named, and, on examination, the collection was found to comprise the following eight species:— *Cidaris*, sp. nov., *Salenia Fraasi*, *Cyphosoma cenomanensis*, *Orthopsis*, sp. nov., *Echinobrissus Goybeti*, *Nucleolites similis*, var., *Hemiaster cenomanensis*, and *H. similis*. All the known forms were found in beds of Upper-Greensand age in the Lebanon, Europe, &c., except the *Nucleolites*, which was a Chloritic-marl species. Of the eight species all were found in the Argillaceous limestone, five in the Coralline, and two in the Nodular limestone, the last two, *Hemiaster cenomanensis* and *H. similis*, occurring throughout. Under these circumstances there appeared no reason for assigning the beds of limestone to different stages of the Cretaceous system.

3. "On some Dinosaurian Vertebræ from the Cretaceous of India and the Isle of Wight." By R. Lydekker, Esq., B.A., F.G.S.

The Author, in 1877, described some Dinosaurian caudal vertebræ and a femur from the Lameta beds of India (Middle or Upper Cretaceous), and as he was unable to find any described forms that

resembled them, he proposed for them a new genus, which he called *Titanosaurus*. Two species were represented. After noticing the principal characters of the Indian specimens, he showed that some caudal vertebræ in the British Museum, collected by the late Mr. Fox from the Wealden of Brook, in the Isle of Wight, agreed in form with those found in India and were, in fact, intermediate in some respects between the two Indian species. An inquiry into the associated remains at Brook indicated that the caudal vertebræ in question probably belonged to *Ornithopsis*, and this probability was supported by the structure of certain American fossil genera placed by Marsh in the same suborder, Sauropoda, of the Dinosauria. In any case there is great probability that at least one of the Indian and the Isle of Wight vertebræ should be referred to the same genus.

Some other instances of fossil vertebrates appearing in Indian beds of a rather later geological age than in Europe were noticed.

MISCELLANEOUS.

On Lernæascus nematoxys, *a hitherto unknown Lernæan.* By Prof. C. Claus.

Beneath the scales, especially of the pigmented side, of *Solea monochir* there lives a vermiform parasite 8–10 millim. long, which, when examined by the naked eye, resembles a small Nematode; it glides to and fro by means of slight bendings of its body, after the fashion of the mining caterpillars, in short, narrow, mucous canals. Closer examination, however, shows that we have to do here with a female Lernæan, which has taken on a worm-like form in accordance with its dwelling-place, and has acquired several exceedingly remarkable adaptations. The anterior and posterior extremities of the body taper off gradually, the former easily recognizable by the insertion of the antennæ, the latter by the two furcal processes. As may be seen from the position of the two oviducal apertures, only the extreme hinder end, scarcely 1 millim. long, represents the abdomen; the preceding division of the body, which is nearly ten times as long, with the nervous centre, middle intestine, ovaries, and cement-glands, represents the cephalothorax. On the cephalic part of this the anterior, setigerous, tactile antennæ are inserted; and ventrally the prehensile antennæ, which terminate in strong hooks. The tripartite entomostracal eye is perfectly retained. The mouth-organs consist of a sucking-proboscis armed with two reversed hooklets, and of two powerful foot-jaws. The mandibles are aborted, and the stylet-bristles placed outside of the proboscis are to be regarded as maxillæ. There are three pairs of limbs consisting of minute rudimentary feet originating far apart; the first two pairs are still recognizably biramose; the feet of the last pair

are simple wart-like tubercles, each furnished with two setæ. As a character acquired by adaptation and quite peculiar to the genus, special interest appears to attach to the presence of about *fifty pairs of dorsal, and the same number of ventral, scale-like, finely striated elevations,* which are obliquely elevated and extend over the whole length of the thorax to the commencement of the abdomen, and are of essential service in the gliding-movements beneath the scales of the fish. To these is added, at the anterior end of the head, a median dorsal tubercle, which is clothed transversely with close-set chitinous bands, and probably aids in the boring and mining movements.

Although there could be no doubt that in the parasite here described we had to do with a female Lernæan in the egg-producing stage, the search for younger and smaller forms led at once to an acquaintance with the males and females in the copulatory stage. In this phase of development the sexual animals attain scarcely one third of the length of the pregnant female, and nearly approach the type of the free-swimming jointed Copepoda. The larger males have retained nearly the normal segmentation of the body, and possess two pairs of swimming-feet modified for clinging, followed on the third pectoral segment by a third pair of simple stumps. The smaller and more feebly constructed female shows exactly the same construction of body, except that the segmentation becomes quite retrograde in the thorax and abdomen, which latter tapers towards the extremity and runs out into two furcal joints. In the male animal the thorax consists of five, and the abdomen of four sharply separated segments, of which the genital segment is unusually large, but nevertheless it is exceeded in size by the terminal segment. The latter appears almost scutiform and considerably elongated, in connexion, as may be at once ascertained, with the position of the testes, *which are moved down into the* terminal segment—a very interesting change of position quite unknown to me in any case elsewhere among the Copepoda, but which has become normal in the nearly allied Argulidæ, formerly referred erroneously to the Phyllopoda. The spermatophores are remarkable for their extraordinary size, not only filling the genital segment, which is furnished with two plates, but extending forward nearly to the limit of the antepenultimate thoracic segment. The prehensile antennæ, in the copulatory stage, show the type of the Corycæidæ, and become afterwards very essentially simplified in the females; the parts of the mouth also differ considerably from the form in the pregnant stage, inasmuch as they are destitute of the sucking-proboscis, and possess a different form of the maxillary foot-pair, agreeing in the two sexes. The presence of two wing-like plates on the back of the second thoracic segment seems worthy of notice; they remind one of the characters of the group Pandaridæ. In the female these become considerably retrograde, but are still retained even in the egg-producing stage as two-pointed chitinous pieces.—*Anzeiger k. Akad. Wiss. in Wien*, December 2, 1886, p. 231.

Considerations on the Nervous System of the Gasteropoda.
By M. H. de Lacaze-Duthiers.

In some notes previously presented to the Academy I have shown that, in several aberrant types of Gasteropoda, it was always possible, by means of the law of connexions, to recognize the homologous parts in the innervated organs as well as in the innervant nervous centres, and this notwithstanding peculiar arrangements which seemed to cause the homologies to disappear by masking them.

Before passing to the observation of fresh forms, it will be useful to indicate some facts which must always be taken into consideration in researches of this kind. In fact, in analyses made in order to reconstruct the nervous system of the Gasteropoda, at least as it seems to me that it ought to be understood, the business is to recognize which are the aggregations of ganglionic cells of primary importance, so as not to ascribe too high a value to ganglia which, by their volume and their number, might seem to be very important, although having only an accessory and secondary part to play. We may rest assured that, when an organ acquires considerable proportions, the part of the nervous system corresponding to it, which is represented in ordinary cases only by a few nerves, acquires in these new conditions a development proportional to that of the organ. But the primary centre which presides over the innervation is little, if at all, modified, and it is only in the peripheral portion that changes take place which are often so great as to lead to the belief that they have a morphological importance which does not really exist. In these cases upon the course of the principal nerves deposits of nerve-cells, variable in number and volume, are formed, and the ganglia produced by them, and which may be called *strengthening* or *supplementary ganglia*, are accessory and superadded, and have not the constancy of those which compose the central system properly so called.

In investigations upon this nervous system of the Mollusca, therefore, our preoccupation must be constant; we must endeavour to recognize the ganglia of the first rank in order to distinguish them from those which, being superadded, are secondary. Nature, in multiplying these centres of secondary rank, has, as it were, dissociated the elements. The observer, by a sort of synthesis, must, on the contrary, bring together the superadded parts to reunite them with those which truly constitute the central nervous system.

There are no more demonstrative examples in support of these ideas than those which may be drawn from the study of the mode of innervation of the digestive tube of some Gasteropod Mollusca. In this mode of innervation two things are constant and invariable :—

1. The origin of the cerebro-sympathetic connexions upon the anterior and superior surface of the cerebroid ganglia.

2. The presence of two ganglia, usually spheroidal but always symmetrical, similar and situated in the angle formed by the

œsophagus and the lingual sac near the point where the salivary ducts open.

These two ganglia alone constitute the *stomato-gastric* centre; above they furnish the *salivary* and *buccal nerves*, and below two cords, the *stomachal nerves*, the stoutest and the longest, which follow the œsophagus to innervate the stomach and intestine. It is curious to remark that there issue from the same centre voluntary nerves appropriated to the mouth, and nerves passing to organs which may probably escape the action of the will, such as the salivary glands, the stomach, and the intestine.

In a great many cases the two stomachal nerves divide upon the dilatation of the digestive tube preceding the opening of the biliary duct, and, according as it is of greater or less extent, form reticulations which may vary infinitely in abundance and arrangement. The *Dorides*, the *Pleurobranchi*, the *Haliotides*, the *Tethydes*, and the majority of the Gasteropoda are in this case. But other arrangements occur, and the one now to be considered exists in *Philine*, *Bulla*, *Scaphander*, *Aplysia*, &c.

In these animals, after the lingual bulb, the œsophagus is dilated below into a crop often of vast size, beneath which there is a gizzard furnished with hard pieces destined to triturate the food. This masticatory apparatus is robust and its parts are moved by powerful muscles. Its innervation by a small number of nerves, as in ordinary cases, would have been insufficient, and we note the appearance of a series of small ganglionic centres which, if we considered only their development, would be more important than the centres of origin situated, as we have just seen, in the angle formed by the œsophagus and the lingual sac.

In *Philine* the gizzard is elongated and armed with three lozenge-shaped hard and resistant pieces. Above it is surrounded by a nervous collar having ganglionic nodules of very variable number and size; from it issue six constant nerves, often as thick as the stomachal nerves themselves. These nerves follow the margins of the hard pieces of the armature, and, in passing, innervate the powerful muscles which unite and move them. On arriving at the bottom of the masticatory apparatus they anastomose and form a new collar as highly developed as the former one; finally, from this last issue the nerves of the stomach and intestine. To the right the asymmetrical centre emits an anastomotic branch to this nervous apparatus, which is already so rich, and reinforces it still more.

In *Bulla hydatis* the three masticatory pieces being rather short than long, the gizzard becomes globular; but the same muscles, the same superior and inferior collars, and the same ganglia as in *Philine* occur. Only instead of six nerves uniting the two rings there are only three, and the small ganglionic aggregations are larger and better differentiated.

In *Scaphander* the masticatory apparatus seems at the first glance to be composed only of two pieces; but on searching carefully the third very small one is found hidden between the two larger ones; the three nerves uniting the two rings (superior and inferior) are

very visible upon the back of the muscles. The ganglia, generally three in number, like the hard pieces, are better formed than in *Philine*.

Aplysia has an enormous crop upon which we can easily trace the two great stomachal nerves, which, from point to point, are united by slender nerves the anastomoses of which form a network of not very close meshes. Towards the bottom the muscular tissue is much thickened, and its rigidity shows clearly that it is very powerful. Within the mucous membrane is covered with pyramidal hard pieces, arranged in several rows and of several sizes without being further differentiated. This part is the homologue of the gizzard of *Bulla* and *Philine*.

Here, as in the preceding examples, towards the superior limit of this gizzard there exists a nervous ring, greatly developed and formed by stout anastomotic branches transversely uniting the gastric nerves. From this ring issue parallel branches, which descend, innervating the muscles. Most frequently six of these nerves may be counted. Towards the bottom their anastomoses are less regular than above and their terminal branches pass to the stomach and intestine.

Thus, it will be seen, with the appearance of a masticatory apparatus the number of the nerves and ganglia increases in proportion, it may be said, to the actual development of the modified parts. It is therefore not doubtful that in appearance there is a great difference between the organs of innervation of the digestive tube according as there is or is not a gizzard, that is to say, pieces adapted for mastication. The ganglia and stomachal rings of *Philine*, *Aplysia*, &c. are quite special centres of innervation. But it would not be legitimate to exaggerate their morphological importance; they are dependencies of the stomato-gastric centre, with which they must be joined, instead of separating them from it. It is evident that they are superadded and introduce no modification into the interpretation of the stomato-gastric centre, which always remains the same in its central part and is only modified in a portion of the periphery to respond to new necessities when a masticatory apparatus is added to the digestive tube.

In another memoir I shall show that there are cases in which these observations are applicable even to the peripheral nervous system dependent upon the cerebroid ganglia, and that, by a sort of organic balancing, to employ the language of Geoffroy Saint-Hilaire, the primordial ganglia lose in volume while still remaining perfectly distinct, whilst the superadded cellular aggregations, irregularly disseminated through the course of the nerves, form secondary strengthening ganglia, which make up for the feeble development of the primordial centres.—*Comptes Rendus*, October 4, 1886, pp. 583–587.

Note on Regalecus glesne, *Ascanius.* By James A. Grieg.

This note relates to a herring-king found on the 9th March at Seimstranden, a little to the north of Bergen. It was in water about 2 metres deep, and was landed with some difficulty, in consequence of which, and of the lapse of a week before it was brought to the Museum at Bergen, it had sustained considerable injury. Since 1740, when the first herring-king was found on the Norwegian coast, this makes the fourteenth specimen known with certainty, so that on the average one of these animals has been stranded every ten years. On the English coast these fish occur more frequently; since 1759 twenty individuals have been stranded, or about one in every six or seven years.

The measurements of the *Regalecus* found at Seimstranden are as follows:—

	ft.	in.
Total length	8	0
Length of head	0	9
Diameter of orbit	0	$1\frac{4}{10}$
Distance of anal aperture from tail	2	1

	Total depth.	Elevation of lateral line.
	in.	in.
At the pectoral	$10\frac{5}{10}$	$5\frac{1}{2}$
Between pectoral and anal	15	$4\frac{1}{3}$
At the anal	$13\frac{1}{3}$	$3\frac{1}{2}$

This *Regalecus* is the smallest known specimen, for it is barely 8 feet long, and therefore a little smaller than the individual stranded in Cornwall in 1788 ($8\frac{1}{3}$ feet, Day). Shaw's *Gymnetrus Russellii*, found at Vizagapatam in 1788, measured only 2 ft. 8 in.; but it is uncertain whether this is identical with the northern *Regalecus glesne*. The Bergen *Regalecus* is also remarkable for its great depth, 15 inches, which is about one seventh of the total length, while the proportion varies in other cases between $\frac{1}{9}$ and $\frac{1}{13}$, and even sometimes falls to $\frac{1}{15}$; in the Cornish specimen the proportion was $\frac{1}{10}$.

The pectorals had 12 rays. The number of occipital rays seems to have been 13. The dorsal, which was of a fine red colour in the fresh animal, had 138 rays (125+13); but the existence of a gap behind the occipital rays leads the author to conclude that there were altogether about 145 rays, probably more, as there were many rays broken and removed. If Lütken's supposition, that the number of dorsal rays increases with the age of the animal, be correct, as there is every reason to believe, the small number of rays in this specimen is very natural. Unfortunately the number of rays in the English *Regalecus* of 1788 is not stated; it would have been very interesting to compare the numbers in these two specimens of nearly equal size. The ventrals were represented by fragments $2\frac{3}{4}$ and $1\frac{1}{6}$ in. long.

The end of the tail, as usual in the *Regaleci*, is obliquely truncated; at the extreme tip there was a small scar or mark.

The length of the head, 9 inches, is contained 11·7 times in the total length, so that it is larger in proportion than usual; according to Lütken the proportion varies between $\frac{1}{16}$ and $\frac{1}{21}$. The head showed the typical form of the genus, and, as in the two older and larger specimens in the Bergen Museum, there are no teeth. The apparatus of teeth, mentioned by Collett, on the first branchial arch seems to have about 40 rays, but the head is so much damaged that it is impossible to state the exact number. The tongue also was lost. The pupil was round and deep black, and the iris silvery white in the fresh animal. The silvery-white body had several black cross bands, of which five larger ones extended across the whole side obliquely from above downwards.

This herring-king therefore differs from the typical *Regalecus glesne* only in its comparatively larger head, its greater depth, and the smaller number of rays in the dorsal; but as these characters are very variable, the specimen may be regarded as a true *Regalecus glesne.*

The distance from the tip of the snout to the anus is about 6 feet, or 75 per cent. of the total length, and a proportion so abnormal that the author concludes that a portion of the tail had been lost, as according to Collett the normal proportion is $\frac{4}{10}$ instead of $\frac{3}{4}$. Hence this animal would normally have measured nearly $15\frac{1}{2}$ feet in length, which is not unreasonable, as examples have been met with over 5 metres in length, and this supposition is confirmed by the great depth of the body. It must, however, be remarked that the caudal part was complete and smooth with the exception of the fresh lesion at the apex; the form of the tail most resembled that of the Stavanger specimen of 1881.

The individual was a female with a well-developed ovary. The upper part of the intestine was empty, while the lower part contained a yellowish-brown undeterminable fluid.—*Nyt Magazin for Naturvidenskaberne,* Bd. xxx. p. 232.

Carterius Stepanowii, *Petr.* By H. J. Carter, F.R.S. &c.

This freshwater sponge, which in 1884 was named "*Dosilia* (?) *Stepanowii*" by Dr. W. Dybowski, from a specimen found near Charkow, in Southern Russia ('Annals,' 1884, vol. xiv. p. 60), was also found in 1885 by Prof. Fr. Petr, of the University of Prague, in the neighbourhood of Deutschbrod, in Bohemia, about 60 miles south-east of that city; and his description of it, which is beautifully illustrated, was published in the Czech language at Prague in 1886 ("Dodatky ku Fauně Českých Hub Sladkovodních," Tisdem dra. Ed. Grégra v Praze, 1886). It appears to me to be the same as that discovered by Mr. H. Mills, of Buffalo, New York, in the Niagara River in 1880, viz. *Carterius tubisperma* (Proc. Acad. Nat. Sci. Philadelphia, 14th June, 1881, p. 150).

Thus this remarkable genus of *Spongilla*, first brought to notice

by Mr. Ed. Potts, of Philadelphia, in a specimen found in "a small stream in the late Centennial grounds, Fairmont Park, Philadelphia" (*ib.* "about August 1880"), which he then named "*S. tentasperma*," and subsequently "*S. tenosperma*" (*ib.* p. 357), ending with "*Carterius tenosperma*," its present name, has now been found in Southern Russia and mid-Europe, as above stated.

In the same communication also Prof. Petr has described and illustrated, under the "provisional" name of "*Ephydatia bohemica*," another freshwater sponge, found at Kavasetice, in the same district, wherein the statoblast presents an *incipient* condition of the cirrous development characterizing *Carterius*, with a spiculation which appears to me, from the illustrations, to be very like that of his *C. Stepanowii.*

Lastly, Mr. H. Mills, of Buffalo, in a letter dated 20th Nov. 1886, sent me a specimen of *Carterius* from the Niagara River which he considers allied to *C. latitenta*, Potts (Proc. Acad. Nat. Sci. Phil. 1882, July 10th, p. 12), wherein the expanded portion of this development presents itself under the form of a cup, with even, circular margin (that is, entirely without cirrous appendages), whose bottom is pierced by the upright tubular part in the usual way; which "form" appears to prevail generally in the statoblasts of this variety.

On some Optical Properties of the Peristome of Mosses. By M. J. Amann.

The author describes some curious properties of the peristome of mosses when under polarized light. These properties, which have not been described up to the present time, deserve a closer study. According to M. Amann's observations, sometimes the outer layer of the peristome (exostome), sometimes the inner layer (endostome) rotates the plane of polarization and exhibits, when a thin plate of mica or of selenite is interposed, very brilliant colours, varying with the position of the two Nicols relatively to each other. This action of the peristome on polarized light varies from one family or genus to another. It is occasionally almost nil (Pottiaceæ, Weissieæ); feeble in the Grimmiaceæ and Dicranaceæ; strong in the Mniaceæ and Hypnaceæ. There appears to exist a curious relation between these optical properties and the amount of tannin contained in the membranes: thus, those richest in tannin are the most active; the endostome of *Camptothecium lutescens* affords a particularly good illustration in this respect.—*Bibliothèque Universelle, Archives des Sciences*, Dec. 15, 1886, p. 585.

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XXXI.—*The Relationships of the Porifera.* By Dr. G. C. J. VOSMAER. (Translated by ARTHUR DENDY, B.Sc., F.L.S.*)

IT is now eighteen years since Oscar Schmidt remarked, "A natural system of sponges still awaits its founder;" and this is still the case. A qui la faute? When Schmidt published his first works on Sponges the subject was certainly in a worse condition than at the present day, and he was the first who earnestly endeavoured to inaugurate a better state of affairs. It is his merit rather to have foreseen than seen many natural relationships, and thereby to have laid the foundation of a natural system. We have, however, already seen in the systematic part of this work that Schmidt's system can, in short, no longer be used. The facts which we owe to more recent methods of research have thrown a somewhat different light upon these matters, and hence I believe that I was right in making several modifications in the system—modifications which I hope are, in part at any rate, at the same time improvements. I have repeatedly pointed out that the system is still far from being a natural one; but I have as much as possible taken into consideration genealogical questions. Meanwhile the linear arrangement of the group necessarily

* From Dr. G. C. J. Vosmaer's work on the Porifera in Bronn's 'Klassen und Ordnungen des Thierreichs' (1887), pp. 472–481.

adopted in the systematic portion of the work could not clearly elucidate questions of relationship, and hence the necessity for a more careful consideration of the question in this place. Many people have placed the calcareous sponges in too close connexion with the siliceous ones, largely owing to Fritz Müller's vain attempt to derive the calcareous and siliceous structures from horny fibres. I have here followed the main division of Gray, and have accepted two classes—Calcarea and Non-calcarea—a proceeding as to the correctness of which people seem to be more and more agreed. The first spongologist of the present day, F. E. Schulze, accepts this classification*. There are absolutely no transitions between the two classes; and since the spicules appear at a very early date in the larva, it can be only the very earliest developmental phases which are common to the two. This primary division thus appears to be a natural one.

The Porifera Non-calcarea appear to me to be divisible into three orders:—Hyalospongiæ, Spiculispongiæ, and Cornacuspongiæ. The Hyalospongiæ † all have this in common:—their skeleton is composed of spicules based upon the triaxonid type. The Cornacuspongiæ are distinguished by a new element, spongin; and in the Spiculispongiæ the "spicula" are the chief distinguishing feature. It appears to me that the genera within each order are more nearly related to each other than to the genera of other orders; and if this be so, as I shall immediately endeavour to show, then the classification is a natural one. These three orders nevertheless are not nearly so sharply separated from one another as are the two classes. We do not, it is true, know of any direct transitions from the Hyalospongiæ to the other orders. Still there are certain facts which perhaps indicate a possible connexion. Schulze appears to accept no connexion at all when he says, "and however plausible, indeed almost self-evident is the hypothesis that the latter (six-rayed spicules) may also atrophy and give rise to spicules with fewer axes, so that the spicules might even all become monaxonid, we know as yet no Monaxonia in whose spicules we can detect any indication (such as through crossing canals) of a descent from triaxonid spicules" ‡. But we do find in the literature statements to

* 'Ueber den Bau und das System der Hexactinelliden' (Berlin, 1886), p. 32.

† Hexactinellidæ, auctorum; but I prefer on principle to give names with similar endings to equivalent divisions, rather than to abide rigorously by priority. In the case of genera and species, on the contrary, I keep as much as possible to the laws of priority.

‡ *Loc. cit.* p. 34.

this effect, though very sparingly. I refer here to *Stylocordyla borealis* (Lov.), Wyv. Thomson, in which Lovén has actually found the rudiments of the axial cross *. And do not most of the spicules of this sponge indicate that spicules which have such a swelling are originally descended from six-rayed forms? I might further point to the peculiar spicules of *Suberites lobiceps*, O. S. † The so-called "anchor-spicules" [M. ta. $\phi < 90$] are, as is well known, very abundant in Hexactinellids; and the question arises, how far are the similar structures in the Tetraxonina related to them? The same holds true of the little chelate spicules ‡ of the Desmacidonidæ.

The possibility that all originally descended from Hexactinellid-like ancestors, and that the occasional isolated appearance of spicules with remnants of a triaxonid form may thus be attributed to atavism, is to me personally not unlikely.

This occasional appearance is much more common than people think; I have found many sponges in which there are a few rudimentary six-rayed spicules lying among the normal ones. This is somewhat analogous to the case of men with rudimentary tails or with extraordinary hairiness. And so it is with those Halichondrine forms which, in the arrangement and form of the parts of the skeleton, recall certain Suberitidæ (*Clavulina*). The common characters of all the three orders named are more numerous and more important than those of the two classes, and thus they are more intimately connected.

Coming now to consider the closer relationship of the forms within each order, no one will take exception to the Hyalospongiæ as a natural group. The mutual connexion of the Spiculispongiæ rests upon the following grounds:—The examination of the different suborders of the Spiculispongiæ appears to me to show unmistakable signs of degeneration. Leaving out of account the Lithistina, which, owing to their peculiar knotty structures, stand somewhat on a separate footing (although the condition of the canal-system and ground-substance, as well as the often well-marked tetraxonid skeletal elements, distinctly show their affinities), we may perhaps assume that the Tetraxonina represent the older forms. The presence of distinct tetraxonid spicules, a more or less distinctly radiate arrangement of the skeleton, a more or less distinctly pronounced cortex, the granular character of the ground-substance, and a rather highly developed canal-system are their characteristics. We see all this most

* I may in the meanwhile refer to my work "Sponges of the 'Willem Barents' Expedition," 1880 and 1881, pp. 10–12.

† Spong. atlant. Gebiet. p. 47, pl. v. fig. 5.

‡ $=$ *anc.*^{2} and *anc. anc.*

distinctly in the Geodidæ and in many Ancorinidæ. Amongst the Corticidæ and Plakinidæ a marked reduction in the multiplicity of the skeletal elements has taken place; the latter family also show clearly how triradiate spicules, nay even simple styli*, may arise from quadriradiate forms. In the Oligosilicina the reduction of the spicules has gone still further; *Chondrilla* retains only the characteristic euasters † or spherasters ‡. In *Chondrosia* and *Oscarella* the skeleton has completely vanished; but they have retained the characteristic granular condition of the ground-substance. *Oscarella* is nearly related to *Chondrosia*, and *Chondrosia to Chondrilla.* But now the step from *Chondrilla* to *Corticium* does not appear to be very great, and so I believe in the existence of a connexion between the so-called askeletal forms and the true Tetraxonina.

In many Tetraxonina we see a kind of tendency to lose the tetraxonid spicules, and we find more and more frequently the long, smooth, peculiarly shining, radially disposed styli coming to the fore. But the Tethyadæ are forms in which this degeneration has become complete. The arrangement of the smooth shining styli is, however, still markedly radiate; fibres and stellate spicules are still present and also the granular ground-substance. Finally, these same conditions in the Polymastidæ mark a transition to the Suberitidæ.

Turning now to the connexions of the Cornacuspongiæ *inter se*, we find here the newly acquired spongin attaining the first importance, while the spicules ultimately completely vanish. Many *Halichondriæ* still show a resemblance to the Suberitidæ; but the arrangement of the skeleton is always more irregular, *i. e.* less distinctly radiate; and with this fact must be connected the gradual loss of definite external form. It seems to be generally agreed that there is really a close relationship between the Halichondrina and the Ceratina; indeed most of the younger spongologists have repeatedly brought forward new arguments in favour of this view. I refer particularly to the works of von Lendenfeld § and myself ||. I am therefore somewhat surprised that Schulze should seem inclined to lay so much stress upon the entire absence of siliceous spicules.

We have thus considered somewhat more closely the relationships of the Sponges, and the question now arises, How can one represent to one's self their connexion, *i. e.* their descent? From what has been said, every one may judge for himself

* = *Stabnadeln*, Vosm.; *acuates*, Bk.

† "Sternchen." ‡ "Kugelsternchen."

§ 'Zoologische Anzeiger,' 1884, no. 164.

|| Mitth. zool. Stat. Neapel, Bd. v. 1884, p. 490.

whether what follows is purely hypothetical, and how far it is so. What is the ancestral form from which the Sponges have been derived? This question has been answered in a variety of ways; but all the answers are hypothetical, for our embryological knowledge is too limited and imperfect. It appears to me that it is as yet simply impossible to say what may have been the appearance of the ancestral sponge. We have, it is true, reason to believe in the existence of a free-swimming form, which may have looked something like the larva of a siliceous sponge, but not like that of *Sycandra* or similar certainly aberrant forms.

Before Leuckart's time (1854) the Sponges were regarded as undoubted Protozoa. But when their complex structure gradually became known, and especially after Huxley's statements concerning the presence of ova and spermatozoa in *Tethya*, Leuckart first expressed the opinion that the Sponges belong to the Cœlenterata; and, indeed, up to a short time ago this was the generally accepted hypothesis; until at length the third possibility was perceived, namely that they might occupy a separate position between the two. This view has again found an advocate in Heider's latest work. In 1880 I indicated it in my Inaugural Dissertation. Balfour * is of opinion that they form an "independent stock" of Metazoa, and Sollas also. There can scarcely be any doubt that the Sponges are not Protozoa. It is also certain that there are, on the other hand, important differences between true Cœlenterata and Sponges. Even those investigators who enthusiastically maintain the Cœlenterate nature of the Porifera place them as a natural, separate group, in opposition to the Cnidaria. We are not, however, dealing only with the question, Are the Porifera a subtype of the Cœlenterata or a special type? but also with the phylogenetic reasons. Although the Sponges may not be Protozoa, yet they may have descended from Protozoa. If we can hold in general that the Metazoa are descended from Protozoa, and if we further admit that Sponges are true Metazoa, then forthwith we stand face to face with the question, What are the phylogenetic relations of the Sponges to the remaining Metazoa? With regard to this the results arrived at by Sollas and Bütschli essentially agree. Bütschli maintains "that the Sponges form a group which is completely separated from the remaining Metazoa and which originated from the Choanoflagellata (Saville Kent) quite independently." Independently of Bütschli, Sollas came to the same conclusion; he

* 'Comparative Embryology,' i. p. 122.

names the "Phyllum," separately descended from the Protozoa, *Parazoa*, the remainder *Metazoa*. Marshall now stepped forward in opposition, endeavouring further to support the opinion which he had previously expressed. He first said * :—"Porifera and Telifera (*sit venià verbo*) are two divergent branches of the Cœlenterate stock, which have arisen from the common stem-form of the Protactinia." And he now † adds to this :—"It may readily be granted that the ancestors of the Sponges had not yet for very long, perhaps never at all, possessed tentacles, which, however, are something secondary; but they were at least two-layered, and, besides, as we may conclude from the occasionally forthcoming cases of reversion, radiate; they had a mouth-opening and a gastral cavity, from which gastral canals came off centrifugally, and, breaking through the ectoderm, opened freely outwards; and such creatures are, according to my understanding, under all circumstances true Cœlenterates." Schulze ‡ criticizes the views of Bütschli, Marshall, and the older authors, and himself comes to the conclusion that very probably the oldest sponges possessed no radial evaginations of their central cavity, but were, like the *Olynthus* amongst the Calcarea, simply sac-shaped.

Let us now examine these two views, which so strongly contradict one another. I will begin with Marshall's theory, as it is the most definitely formulated. It rests mainly, as the author himself allows, on the radiate structure, which, however, according to him, the Sponges have lost. He views Sponges as degenerate animals, and indeed degenerate Cœlenterates, a view which Dohrn, ten years before, and also Balfour § had already put forward as possible. Balfour is, however, very doubtful:—"It might perhaps be possible to regard Sponges as degraded descendants of some Actinozoon type, such as *Alcyonium*, with branched prolongations of the gastric cavity; but there does not appear to me to be sufficient evidence for doing so at present. I should rather prefer to regard them as an independent stock of the Metazoa." I believe every one who has engaged in spongological researches is often struck with the idea of degeneration, but cannot always bring this into harmony with other things. And hence, perhaps, Balfour's doubt. It appears to me that people have always regarded the question too generally, and, on the other hand, too one-sidedly, and have not thought of the

* Zeitschr. für wiss. Zool. Bd. xxxvii. p. 246.
† Jen. Zeitschr. Bd. xviii.
‡ Sitzber. Akad. Berlin, 1885.
§ 'Comparative Embryology,' i. p. 122.

possibility that what is true for one division of the Sponges is certainly false for another. It seems to me, and everything points to this conclusion, that most siliceous sponges are degenerating in a certain respect, but that in the Cornacuspongiæ a new force has stepped in which again lifts them up, and that the Calcarea of the present day are also developing progressively. But even if most Sponges do show numerous traces of degeneration, yet they need not on that account be descended from Cœlenterates. The differences between the two groups are so great that even the most zealous advocate of their cœlenterate nature, as we have seen, puts their phylogenetic connexion a very long way back; and, in spite of this, Marshall's theory is scarcely tenable. Granted that the nearest ancestors of the Sponges were "at least two-layered," granted also that they were "radiate," even that they possessed a "gastral cavity" (*s. l.*), &c., yet this shows nothing. Such creatures are still not Cœlenterates. Marshall, to be sure, goes further, and claims for the sponge-ancestor a "mouth-opening" and a "gastral cavity" with centrifugal canals; but there are no grounds for this. For, as Heider again asserts, the so-called osculum of the Sponges is neither homologous nor analogous with the mouth of Cœlenterates, and the large internal cavity present in many Porifera has just as little claim to the significance of a gastral cavity as, in short, the canals in connection with it have to be placed on the same footing as the peripheral canals of the Cœlenterata. There is not a single reason for regarding the central cavity in Sponges as a gastral cavity. Even supposing that its epithelium may, perhaps, take up nutrient particles, still it has never yet been observed that the cavity is the true digestive cavity, κατ' ἐξοχήν *. This is, moreover, very improbable for several reasons; for, in the first place, this momentous cavity is not always present, or it is very small; and, in the second place, its position and arrangement are very unfavourable for the retention of solid bodies. It may be answered, that it has not yet been demonstrated that proper solid nutriment is taken in. Since, however, it is certain that particular sponge-cells *can* take in solid bodies, and do so very readily, and, further, that sponges placed in reservoirs which are kept as clean as possible, and where the inflowing water is freed from suspended particles, perish more rapidly than others which are kept in dirty (*sit venia verbo*) reservoirs, it is, on this ground alone, more probable that solid nutriment is a vital question with them. The unfavourable nature of the position of the so-called gastral cavity depends

* Häckel's assertions rest upon pure imagination.

often (much oftener than at first one is inclined to believe) upon the fact that the large aperture faces downwards, and upon the relatively powerful current, the so-called gastral cavity being the common canal, the cloaca, into which all the other canals open. And even in cases where spicules project into the "stomach," which might eventually retain nutriment, these spicules are constantly curved towards the osculum so as to prevent entrance, but in no way preventing exit.

Their developmental history teaches us that the Porifera and Cœlenterata separate from one another at a very early date. As Heider correctly and expressly insists, the Sponge-gastrula attaches itself by the mouth, while the Cœlenterate-gastrula attaches itself by the aboral pole. Thus the two types proceed together as far as the gastrula-stage, but then each goes its own way. Finally, Balfour * has already pointed out the early appearance and great development of the mesoblast as a striking difference between Porifera and Cœlenterata. Thus if I cannot agree with those who would regard the Sponges as Cœlenterates, I also do not agree that they have descended from Cœlenterates.

In considering the question whether the Sponges have descended from Protozoa we must, in order to avoid misunderstanding, distinguish between a direct descent (*i. e.* regarding the question as Saville Kent does, and then, as a necessary consequence, viewing the Porifera as a progressively developing group) and an indirect descent (supposing Sponges in general or sponge-ancestors to have been derived as Metazoa from Protozoon colonies). The latter view appears to me the most plausible. We can hardly imagine a direct descent. I will not further urge the conclusion that Sponges are not colonies of Monads or Choanoflagellata; but the differences between the Sponges of the present day and the Protozoa are also so great that we can only properly discuss the question whether the ancestors of Sponges descended from Protozoa; and in this sense I can only answer the question in the affirmative, it being still left quite uncertain in what manner the transition was brought about.

It is well known that Balfour started with the Amphiblastula larva, and saw therein the ontogenetic recapitulation of a parent-form which stood between Protozoa and Metazoa. He assumes that the cells of the two halves differentiated themselves functionally into *nutritive* (the amœboid cells) and *respiratory-locomotive* (the flagellate cells). When the sponge became attached these (locomotive) flagellate cells must for the most part have become functionless, while the amœboid cells,

* 'Comparative Embryology,' ii. p. 285.

being of great use to the whole colony, increased. Hence arose a larger external layer of nutritive cells and a small internal layer of now chiefly respiratory cells.

This theory of Balfour's is criticized in Heider's latest work, and the arguments brought forward certainly seem to us very powerful. "Balfour," says our author, "was wrong in summarily dismissing the question whether we have not perhaps in the amphiblastula-larva a cenogenetically modified form." As such Heider considers it, especially as the amphiblastula is present only in the Calcarea, and not in all of these.

Secondly, Heider thinks that we have yet no right to regard the amœboid cells as more proper to the reception of nutriment than the flagellate cells. He points here to the Salpingœcæ and Codosigæ, and maintains that our knowledge of the mechanism of the motion of the flagellum is too slight to enable us to form an opinion as to the powers of the collared cells. In the third place, he objects that Balfour does not explain why the larva should have given up free movement.

Heider now puts forward another hypothesis, based upon his recent researches on *Oscarella*, wherein he assumes "that the cavity of invagination is the gastral cavity, and that the cells of the invaginated layer, thus in *Sycon* the flagellate cells, were originally the nutrient elements." The gastrula-like parent-form of the Sponges then gave up its free-swimming mode of life "because it placed its mouth against the surface of some solid body, in order in this manner to seek food on the surfaces of stones swarming with minute organisms of all sorts." The attachment took place originally in the manner which Heider discovered in *Oscarella*, *i. e.* only at single points, so that water could flow into the gastral cavity all the time. There is certainly much to be said for this hypothesis; but if Heider objects that Balfour does not explain why the ancestral form becomes attached and gives up its free-swimming habit, we may, on the other hand, object that Heider does not say why the blastula-like larva ever turns into a gastrula. What was the *principium movens* in this case? Everything appears to me to be still pure hypothesis, to which one can only oppose other hypotheses. I will willingly grant the possibility that the Metazoa may have been derived from colonies of Protozoa. This is very probable, but not necessary; but so long as we do not yet know which cells of the sponge and of the sponge-larva are nutritive * and which subserve respiration, so long will it be of

* Poléjaeff considers it to be tolerably well shown that the collared cells are very badly adapted to taking in food, and he supports this hypothesis chiefly on mechanical grounds. It must not be forgotten, however, that as yet we know scarcely anything of micro-mechanics.

little avail to seek to explain how a sponge-larva or a primitive sponge has arisen from a colony of Protozoa. Balfour's theory is based upon pure assumption, and so is Heider's. It would be just as possible that, after the functional differentiation had taken place in the cells of a colony of Protozoa, the larva became, owing to the formation of spicules, too heavy to swim and sank to the ground, wherein lies a great incentive to become attached. The early, often very early, appearance of the spicules may be urged in favour of this view. But all this, as we have said, is as yet pure hypothesis, for which certainly much may be adduced; but it appears to me still rather purposeless to philosophize much about the matter.

If we accept a free-swimming form as the ancestor, and suppose further that solid structures became secreted in certain cells (thereby conferring an advantage in rendering these delicate forms of life less subject to fall a prey to other animals), then we must at the same time believe that in one group calcareous and in another siliceous matter was developed. But this new development led to the restriction, nay finally even to the complete prevention, of free movement, and thereby a higher animal development was precluded. Sessile animals must develop in a special direction in order to maintain the struggle for existence. Nutrition and respiration must be assured; hence, though the degree of development is a low one, yet a well-developed canal-system has been formed.

A second supposition to which we are forced is that Sponges originally lived in tolerably great depths. The oldest forms are, emphatically, deep-sea forms. When, at a later date, they also lived in shallow regions, we see in arrested development the consequences of such a proceeding. The whole class of *Porifera non-calcarea* appears to indicate this. First the skeleton degenerates, the relative amount of silica decreases, and the variety of spicular forms is step by step reduced. At the same time the independent characteristic form is lost; but in certain examples the canal-system develops progressively, not in constant, although probably direct, or inverse relation to the skeletal system.

Thus from the primitive form have arisen, in the first place, the Calcareous Sponges, a group in which the canal-system is most complex in those forms which show degeneration in the skeleton. From the primitive form of the Calcarea, perhaps an *Olynthus*-like sponge, arose, on the one hand, the *Asconidæ*, and, on the other, the ancestors of the Sycons, from which the *Syconidæ* of the present day have been developed; but also, as we have fairly good reasons for believing from Poléjaeff's researches, the *Leuconidæ* and *Teichonidæ*. The position of the *Pharetronidæ* remains doubtful.

In the second place, from the primitive form have been developed the Siliceous Sponges, and certainly forms with triaxonid spicules. From these arose first the fossil and recent *Hyalospongiæ*, then, by the disappearance of the proper triaxonid spicules and the formation of tetraxonid spicules, the *Tetraxonina.* The stock which gave off the lateral branch *Hyalospongiæ* produced later on the branches *Lithistina*, *Geodidæ*, and *Ancorinidæ.* From the *Ancorinidæ* arose the *Plakinidæ* and *Corticidæ*, and doubtless also the *Chondrosidæ* and *Halisarcidæ.* One portion, however, gave off the branch *Tethyadæ*, then the *Polymastidæ* and *Suberitidæ*, while the main stem, always degenerating, ran out into the *Halichondridæ.* The newly acquired spongin developed more and more and made the spicules superfluous; thus arose progressively the *Spongidæ*, *Aplysinidæ*, and *Darwinellidæ.*

As already said, I wish to make no definite assertions concerning the main stem, but only to give a possible picture of the ramification of the most important branches.

There has also been much dispute about the question of the germinal layers. Schulze, after several vacillations, has finally expressed himself very decidedly:—"In addition to the collared cells of the flagellated chambers the whole of the single-layered and continuous epithelium, composed of pavement-cells, lining all the cavities, passages, and canals of the exhalant system, from the exhalant openings of the flagellated chambers to the margin of the oscular opening, is formed from the *endoderm*" *. On the other hand, "the layer of flattened epithelium which clothes the outer surface of the sponge and all the inhalant fissures and canals, from the free surface to the inhalant pores of the flagellated chambers, is formed from the *ectoderm*" †. The remainder of the body is derived from the mesoderm. Schulze certainly seems to wish to extend these remarks, in the first instance applied to *Plakina*, to the entire group of Sponges. According to Marshall ‡ the larva (of *Reniera filigrana*) consists of an "ektoderm" and "cœnoblast," which later on divides into "entoderm" and "mesoderm." From this "entoderm" arises the entire canal-system, while the "ektoderm" furnishes only the epithelium which clothes the outside of the body. The third very different view is that of Gœtte. According to him § the larval ectoderm vanishes, and consequently the entire sponge is formed from endoderm.

* Zeitschr. für wiss. Zool. Bd. xxxiv. 1880, p. 438. † *Loc. cit.*

‡ Zeitschr. für wiss. Zool. Bd. xxxvii. 1882, pp. 221–246.

§ 'Abhandlungen zur Entwickelungsgeschichte der Thiere,' iii. Untersuchungen zur Entwickelungsgeschichte von *Spongilla fluviatilis.*

In the presence of such contradictory opinions, all of which, without exception, have very slight foundation in fact, it certainly seems best at present to keep silence. According to most authors the "endoderm" and "ectoderm," whatever may be their distribution in the body, furnish only the epithelia. All the rest—genital products, skeletal system, in general the body proper—is formed from "mesoderm." Every spongologist will doubtless, then, be somewhat startled to learn from Kleinenberg * that there is generally no mesoderm present.

We may shortly sum up our results in the following sentences:—

1. The Sponges must not be classed amongst the Cœlenterata. They form a type of their own.

2. The Sponges are probably descended from free-swimming forms, which, originally without supporting structures, ultimately developed a strong skeleton.

3. These primitive forms lived at great depths.

4. Coincidently with life at less depths degeneration of the (siliceous) skeleton took place.

XXXII.—*A Reply to Dr. G. J. Hinde's Communication "On the Genus* Hindia, *Dunc., and the Name of its Typical Species."* By Prof. P. Martin Duncan.

After a careful study of Dr. Hinde's paper (Ann. & Mag. Nat. Hist. Jan. 1887, p. 67) I find that it adds very little to our previous knowledge of the interesting Silurian sponge. It is important that the geographical range of the form should have been increased, and it is exceedingly satisfactory that Dr. Hinde should have been able to find some siliceous spicules the shape of which corroborates the statement made by me that the form resembled a tetraclade lithistid. The bulk of the paper consists of criticisms, partly self-contradictory, however, and unsatisfactory in their tone, and partly useful in re-exposing possible errors which had already been discovered by Dr. Rauff.

Dr. Hinde endeavours to explain the strong contradiction regarding the value of Rœmer's specific diagnosis by asserting that the casts described by that author are recognizable as the casts of the species *H. fibrosa* = *H. sphœroidalis*, nob.

* Zeitschr. für wiss. Zool. Bd. xliv.

But that is merely shifting the argument away from the proper and only path. Rœmer regarded the casts, which he described very well, as those of a Favositoid coral, and Dr. Hinde states in a footnote that "Ferd. Rœmer does not stand alone in making this mistake." There is no possibility of a zoologist classifying a lithistid sponge with Rœmer's species by following his descriptions. Dr. Hinde, knowing that the fossils erroneously described by Rœmer are casts of a lithistid sponge, has added to our knowledge; but Rœmer was not aware of the fact, and did not state it. I do not see that Dr. Hinde has improved his position, and in fact he shows that Rœmer had not seen the form in any other state of preservation than that of a cast; and we have yet to learn, as palæontologists, that the correct delineation and slight description of a cast is to be accepted as a correct and useful specific diagnosis of the perfect form.

Fossil sponges are described according to their shape, the shape and arrangement of their spicules, and the nature of their outer (if there are any) and inner spicular elements; but Rœmer, whilst he noted the shape of the species, wrote nothing about spicules or their arrangement; he knew nothing about them, and did not describe the species "*fibrosa*" as the cast of a sponge. He considered the form to belong to a species already described by Goldfuss.

The following is his description (Die Silur. Fauna d. westl. Tennessee, p. 20, pl. ii. figs. 2, 2 *a*, *b*):—

"*Calamopora fibrosa*, Goldfuss, Petref. Germ. i. p. 82, t. xxviii. figs. 3 et 4, p. 215, t. lxiv. fig. 9.

"*Favosites fibrosa*, Lonsdale.

"Zollgrosse, kugelige Massen, welche auf der ganzen Oberfläche, mit sehr kleinen unregelmässig polygonalen unmittelbar an einander stossenden Zellen-Mündungen bedeckt sind und im innern aus sehr regelmässig von dem Mittelpunkte nach Aussen grade und straff austrahlenden und nach Aussen sich verdickenden prismatischen haarförmig dünnen Röhrenzellen bestehen. Es ist mir nicht zweifellos ob die Stücke wirklich der Goldfuss'schen Art angehören."

The genus *Hindia* and its species were thus described by me (Ann. & Mag. Nat. Hist. July 1879, p. 91):—

"Genus Hindia.

"The body is free, without an involution of the texture, and consists of a small central space occupied by spicules

which soon form a series of bifurcating, long, straight, radiating canals, which open at the surface. The spicule element is calcareous, more or less in the shape of a stemmed tripod, with four limbs, and swollen or fringed at the ends, where junction takes place in the others.

" The skeleton is remarkable for its regularity.

"*Hindia sphæroidalis*, mihi.

" The sponge-body is spheroidal. On the surface are papilliform eminences corresponding with the ends of canal-spicules. Centrally the spicules are unattached, are tripod-stemmed in shape, with swollen extremities, and have papillose limbs. Canal-system occupying much space; canals straight, narrow, radiating, opening into their neighbours, and formed by combinations of tetraclade spicules resembling those of the central part, and very regular in shape and size."

It does not require much knowledge to become aware that the last description enables any one to recognize the species, and that the diagnosis by Rœmer is insufficient, incorrect, and misleading.

If Rœmer's description is correct enough to carry the specific name he gave, why did not Dr. Hinde give the readers of his Cat. Fos. Sponges Brit. Mus. 1883, p. 57, the opportunity of having it before them? The description there given of the species cannot be made to tally with Rœmer's, and it is not that which I wrote. It is a new one by Dr. Hinde; and I am free to confess it is not an improvement, especially as it introduces the erroneous statement that from four to six short arms radiate in different directions. Six arms are not found.

Dr. Hinde in his paper offers new evidence against the adoption of the specific name which I gave to *Hindia*. He says " Prof. Duncan does not seem to be aware that even if he substantiated his claim to the name he proposed as against that of Rœmer, there is yet another bar to its adoption, since the same species in the interval between Rœmer's and Duncan's work was described by Prof. Hall, of Albany, under the title of *Astylospongia inornata*."

Then follows the extraordinary admission, " The description in this case is indeed very meagre, and, as no figures are given, it might *fairly be alleged* * that it is insufficient for the recognition of the species"! The critic proceeds, " That, however, the *A. inornata*, Hall, is the same as *Hindia fibrosa*, Rœmer, I am *fairly confident* *, as I have myself collected

* Italics mine.

from the same strata, in the localities mentioned by Hall, the fossils answering to his description, and they are identical with Rœmer's forms."

I was certainly in ignorance of this "bar," and I now know that it is a frivolous impediment. In fact, if I had suggested this weak piece of reasoning, Dr. Hinde would have been justified in considering that I had not been paying compliments to his intelligence as a zoologist. *Hindia sphæroidalis*, mihi, is the correct name of the fossil.

The concluding part of Dr. Hinde's next paragraph places me in a difficulty. He considers that I have made errors of observation, "which, to spare Prof. Duncan, it would be preferable to pass over in silence." If that remark is sincere, and really means what it states and infers nothing else, I can only say that, whilst I am obliged to Dr. Hinde for his good will, I decline to let him or anybody else sacrifice the cause of truth to save my feelings. I have never permitted and shall never allow personal considerations to stand in the way of the truth. I venture to state that I have never hesitated to admit an error when I was satisfied that it was one, and to make all the compensation possible. But if there is any other and uncharitable meaning to be applied to Dr. Hinde's words, I must say that they were written in the worst possible taste.

The subjects at issue are the mineral condition of the fossil and the nature of *Palæachlya*. I stated, and it is undeniable, that the spicules are calcareous, and that they are penetrated by an organism which did not, judging from the modern example, live in silica. I hold to that opinion as true, and the slightest examination of the papers I have written on *Palæachlya* and its modern representative, and their comparison with the paper on the nature of the alga which enters and destroys the siliceous spicules of the present day, will suffice to show that there is no contradiction on my part. The silica-perforating organism in no way resembles *Palæachlya*, and there are no proofs of its presence in *Hindia sphæroidalis*.

It appears that the *Palæachlya* passed in and out of the sponge-spicules and is now seen in the infilling mineral, which I venture to maintain was calcareous originally, and doubtless full of organic matter when it was first introduced. This belief is quite unaffected by the possible grave error of interpretation—not of observation—of which Dr. Hinde accuses me at second-hand, following Dr. Rauff. When I read Dr. Rauff's exceedingly considerate and truly scientific paper I was greatly exercised in my mind about the tremendous mistake I had made in taking silica to be calcite and arragonite.

I must state, however, in extenuation that I etched the surface of my section with hydrochloric acid, and the results led me to believe in the presence of carbonate of lime. Within the last few days I have applied the same acid to the reverse of a polished specimen in the British Museum, and found effervescence not to be confined to the spicular parts. I cannot but believe that I examined an imperfectly silicified portion of the infilling material. That some specimens have a perfectly siliceous infilling I am now well aware. With regard to the replacement of siliceous lithistid spicules by carbonate of lime I have had no doubt for a long time, and the careful reasoning of my friend Prof. Sollas convinced me. Moreover, lately Prof. Hodgkinson has given me the chemical proofs of the possibility of the replacement. Nevertheless, being still satisfied regarding the nature of the perforating organism, I cannot give my adhesion either to Dr. Rauff's or Dr. Hinde's condemnation of the hypothesis of the existence of originally calcareous lithistids, especially when it is quite possible that the siliceous spicules of *Hindia* discovered by Dr. Hinde may be silicifications of originally calcareous spicules. Whenever the evidence to the contrary satisfies me, I shall at once acknowledge my error.

March 1887.

XXXIII.—*On the Rhopalocera of Northern Borneo.*—Part II.* By W. L. Distant and W. B. Pryer.

Fam. **Erycinidæ.**

Subfam. *Nemeobiinæ.*

95. *Zemeros albipunctata.*

Zemeros albipunctata, Butler, Cist. Ent. vol. i. p. 236 (1874).

96. *Zemeros emesoides.*

Zemeros emesoides, Felder, Wien. ent. Mon. iv. p. 396. n. 10 (1860).

Settling on grass in forest-paths; not common.

97. *Abisara Savitri.*

Abisara Savitri, Felder, Wien. ent. Mon. iv. p. 397. n. 12 (1860).

98. *Abisara Kausambi.*

Abisara Kausambi, Felder, Wien. ent. Mon. iv. p. 397. n. 11 (1860).

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* For Part I. see above, p. 41.

99. *Abisara telesia.*

Abisara telesia, Hewitson, Ex. Butt. ii. *Tax.* t. i. figs. 1, 2 (1861).

100. *Abisara orphna.*

Emesis orphna, Boisduval, Sp. Gén. i. t. xxi. fig. 4 (1836).

Fam. **Lycænidæ.**

101. *Poritia pellonia*, n. sp.

Male. Anterior wings above shining bluish green, the costal and outer margins and a large discal patch black; the black costal margin is more or less broken at a short distance from base; the discal patch occupies the posterior half of cell and terminates in an "hourglass-shaped" spot bounded by the lower median nervule and the submedian nervure; the outer margin is broken and contains four bluish-green spots: posterior wings above very dark plumbaginous, with a central longitudinal bluish-green streak, the fringe greyish, inwardly blackish. Wings beneath somewhat similar to those of *P. pleurata*, Hew.

Exp. wings 30 millim.

102. *Curetis minima*, n. sp.

Male. Wings above pale, shining, reddish, inclining to dark orange-yellow; costal, outer and inner margins, and apex of anterior wings dark fuscous, the dark apical coloration occupies end of cell, and the inner marginal dark border is somewhat obsolete near the middle, the extreme base of wing is also more or less infuscated: posterior wings with the costal, outer, and subabdominal margins dark fuscous, broadest at anal angle, the abdominal margin pale greyish brown. Wings beneath pearly grey, more or less covered with minute dark speckles: anterior wings with the apical area palely infuscated, a discocellular spot at end of cell and a submarginal row of very small spots dark fuscous, a discal waved and broken series of obscure lunulate spots outwardly margined with fuscous, between which and outer margin is a very obscure brownish fascia: posterior wings similar to anterior, but without the dark discocellular spot to cell.

Female. Wings above dark fuscous: anterior wings with a large central orange-yellow patch, as in *C. insularis*: posterior wings with a larger central orange-yellow patch than in *C. insularis*, and which is very obscurely and narrowly connected with base. Wings beneath as in male.

Exp. wings, ♂ 25 millim., ♀ 28 millim.

This species is distinguishable by its very small size and the pale reddish hue of the male. It much resembles in pattern *C. insularis*, but the markings beneath are very different.

103. *Gerydus petronius*, n. sp.

Female. Resembling *G. symethus* above, but differing in the following particulars :—Anterior wings, the ground-colour paler greyish white, and the apical fuscous area oblique inwardly and not sinuated : posterior wings above wholly pale greyish white, excepting the costal area which is fuscous. Wings beneath somewhat resembling those of *G. symethus*, but the anterior wings paler in hue. The species is also smaller in size.

Exp. wings ♀ 27 millim.

104. *Paragerydus fabius*, n. sp.

Female. Wings above fuscous brown ; posterior wings with the posterior margin from anal angle to near lower subcostal nervule broadly greyish white. Wings beneath greyish white, somewhat sparingly spotted and mottled with brown, these brown spots confluent and forming a broad and irregular transverse submarginal fascia to anterior wings, and a broad spot near apex of posterior wing ; both wings with a series of small marginal greyish-white spots, inwardly shaded with blackish.

Exp. wings 28 millim.

105. *Logania obscura*, n. sp.

Anterior wings above obscure pale bluish dusted with brownish, costal margin pale brownish, apex and outer margin broadly darker brownish : posterior wings above pale brownish. Wings beneath greyish, dusted and mottled with pale obscure brownish.

Exp. wings 19 millim.

106. *Allotinus unicolor.*

Allotinus unicolor, Felder, Reise Nov. Lep. ii. p. 286. n. 369 (1875).

107. *Spalgis nubilus.*

Spalgis nubilus, Moore, Proc. Zool. Soc. 1883, p. 522.

108. *Cyaniris Lambi.*

Polyommatus (*Cyaniris*) *Lambi*, Distant, Ann. & Mag. Nat. Hist. ser. 5, vol. x. p. 245 (1882).

109. *Zizera lysizone.*

Lycæna lysizone, Snellen, Tijd. Ent. xix. p. 152. n. 49, t. vii. figs. 2, 2*a* (1876).

Abundant, in full blaze of sunshine.

110. *Castalius ethion.*

Lycæna ethion, Doubleday & Hewitson, Gen. Diurn. Lep. p. 490, t. lxxvi. fig. 3 (1852).

111. *Nacaduba aluta.*

Cupido aluta, Druce, Proc. Zool. Soc. 1873, p. 349, t. xxxii. fig. 8.

Abundant.

112. *Nacaduba*, sp.?

Allied to *N. kurava*, Moore.

113. *Nacaduba beroë.*

Lycæna beroë, Felder, Reise Nov. Lep. ii. p. 275. n. 340, t. xxxiv. fig. 36 (1865).

114. *Catochrysops strabo.*

Hesperia strabo, Fabricius, Ent. Syst. iii. p. 287. n. 101 (1793).

115. *Lampides elpis.*

Polyommatus elpis, Godart, Enc. Méth. ix. p. 654. n. 125 (1823).

116. *Lampides ælianus.*

Hesperia ælianus, Fabricius, Ent. Syst. iii. p. 280. n. 79 (1793).

117. *Lampides abdul.*

Lampides abdul, Distant, Rhop. Malay. p. 456. n. 6, t. xliv. fig. 22 (1886).

118. *Polyommatus bæticus.*

Papilio bæticus, Linnæus, Syst. Nat. i. 2, p. 789. n. 226 (1767).

119. *Talicada mindora.*

Lycæna mindora, Felder, Reise Nov. Lep. ii. p. 277. n. 345, t. xxxiv. figs. 9, 10 (1865).

120. *Lycænesthes lycænina.*

Lycænesthes lycænina, Felder, Verh. zool.-bot. Ges. Wien, 1868, p. 281.

121. *Catapæcilma elegans.*

Hypochrysops elegans, Druce, Proc. Zool. Soc. 1873, p. 350, t. xxxii. fig. 12.

Not common. In partial shade.

122. *Drupadia ravindra.*

Myrina ravindra, Horsfield, Cat. Lep. E. I. Co. p. 117. n. 47; *Th. R. l. c.* t. i. figs. 11, 11 *a* (1829).

Local; shady spots.

123. *Drupadia Moorei.*

Sithon Moorei, Distant, Ann. & Mag. Nat. Hist. ser. 5, vol. x. p. 246 (1882).

Common, but local; forest-paths.

124. *Dacalana vidura.*

Amblypodia vidura, Horsfield, Cat. Lep. E. I. Co. p. 113. n. 45; *Th. V. l. c.* t. i. figs. 6, 6 *a* (1829).

125. *Biduanda thesmia.*

Myrina thesmia, Hewitson, Ill. Diurn. Lep. p. 32. n. 16, t. xiv. figs. 25–27 (1863).

126. *Sinthusa amba.*

Hypolycæna amba, Kirby (Hewits.), Ill. Diurn. Lep. *Lyc.* Suppl. p. 32, t. v. *b.* figs. 44–46 (1878).

127. *Cheritra freja.*

Hesperia freia, Fabricius, Ent. Syst. iii. 1, p. 263. n. 19 (1793).

128. *Sithon pallida.*

Sithon pallida, Druce, Proc. Zool. Soc. 1873, p. 352. n. 14, t. xxxiii. fig. 3.

129. *Hypolycæna tharis.*

Oxylides tharis, Hübner, Zutr. ex. Schmett. figs. 883, 884 (1837).

130. *Hypolycæna etias*, n. sp.

Male. Wings above very dark fuscous or blackish: anterior wings with a brown sexual spot on apex of median nervure: posterior wings with the anal angular area from about base to apex of upper median nervule pale bluish white, with a blackish marginal spot between the two lower median nervules, and another spot at anal angle. Wings beneath rufous yellow: posterior wings with the apical third greyish white, containing inwardly a waved black macular fascia, and outwardly a similar marginal series of about four black spots and a waved black marginal line; anal appendage at apex of lower median nervule very long, greyish, with a pale bluish central line above and with a darker central line beneath.

Female. Wings above dark fuscous brown: posterior wings with a submarginal whitish fascia extending from anal angle

to a little above upper median nervule, the fringe whitish. Wings beneath as in male.

Exp. wings, ♂ ♀ 32 to 35 millim.

On the underside this species is allied to *H. tharis*, Hübn.

131. *Narathura centaurus.*

Papilio centaurus, Fabricius, Syst. Ent. p. 520. n. 329 (1775).

132. *Narathura amphimuta.*

Amblypodia amphimuta, Felder, Wien. ent. Mon. iv. p. 396. n. 6 (1860).

133. *Narathura Buxtoni.*

Amblypodia Buxtoni, Hewitson, Ill. Diurn. Lepid. *Lyc.* Suppl. p. 21, t. vii. figs. 68, 69 (1878).

134. *Deudorix epijarbas.*

Dipsas epijarbas, Moore (Horsf. & Moore), Cat. Lep. E. I. Co. i. p. 32. n. 40 (1857).

135. *Loxura cassiopeia.*

Loxura cassiopeia, Distant, Ann. & Mag. Nat. Hist. ser. 5, vol. xiv. p. 200 (1884).

Fam. **Papilionidæ.**

Subfam. *Pierinæ.*

136. *Leptosia xiphia.*

Papilio xiphia, Fabricius, Spec. Ins. ii. p. 43. n. 180 (1781).

Common. Flies slowly about in new clearings and similar places.

137. *Delias pasithoe*, var.

Papilio pasithoe, Linnæus, Syst. Nat. i. 2, p. 755. n. 53 (1767).

138. *Delias pandemia.*

Thyca pandemia, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 346. n. 3, t. vi. figs. 4, 4 *a* (1867).

139. *Delias singhapura.*

Thyca singhapura, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 353. n. 29, t. vii. fig. 2 (1867).

140. *Delias hyparete*, var. *metarete.*

Papilio hyparete, Linnæus, Mus. Ulr. p. 247 (1764).
Delias metarete, Butler, Trans. Linn. Soc. ser. 2, Zool. vol. i. p. 550. n. 1 (1877).

Abundant, but local.

141. *Delias lucina*, n. sp.

Male. Wings above greyish white: anterior wings with the costa, costal nervure, and apical neuration blackish, and with a subapical curved blackish fascia, extreme base of wing dusted with blackish: posterior wings unicolorous, the posterior margin obscurely reflecting the markings beneath. Wings beneath pale greenish white: anterior wings with the costa, costal and subcostal nervures, and apical neuration blackish; apex blackish, containing a central series of five contiguous whitish spots: posterior wings with the neuration blackish, and with a broad marginal blackish fascia extending from apex to anal angle, where it is broadest, containing a series of six whitish spots, the uppermost and two lowermost of which are more or less shaded with carmine-red.

Exp. wings ♂ 81 millim.

This species is allied to *D. Rosenbergii*, Voll., from which it differs beneath by the paler hue, narrower dark border to the posterior wings, and absence of the discal ochraceous coloration.

142. *Prioneris Vollenhovii.*

Prioneris Vollenhovii, Wallace, Trans. Ent. Soc. ser. 3, vol. iv. p. 386. n. 6, t. ix. fig. 3 (1867).

Uncommon.

143. *Catopsilia crocale.*

Papilio crocale, Cramer, Pap. Exot. i. t. lv. C, D (1779).

144. *Catopsilia catilla.*

Papilio catilla, Cramer, Pap. Exot. iii. t. ccxxix. D, E (1782).

Abundant in full sunshine in nearly open fields.

145. *Udaiana Pryeri.*

Udaiana Pryeri, Distant, Rhop. Malay. p. 301, note (1885).

Abundant around bushes on river-banks.

146. *Terias tilaha.*

Terias tilaha, Horsfield, Cat. Lep. E. I. Co. p. 136. n. 62 (1829).

147. *Terias hecabe.*

Papilio hecabe, Linnæus, Syst. Nat. ed. x. i. p. 470. n. 74 (1758).

Abundant everywhere.

148. *Terias Sari.*

Terias Sari, Horsfield, Cat. Lep. E. I. Co. p. 136. n. 61 (1829).

Abundant, but rather local.

149. *Terias harina.*

Terias harina, Horsfield, Cat. Lep. E. I. Co. p. 137. n. 63 (1829).

150. *Terias lacteola.*

Terias lacteola, Distant, Rhop. Malay. p. 466. n. 8, fig. 129 (1886).

Common in some places.

151. *Terias ada*, n. sp.

Allied to *T. lacteola*, Dist., but differing in the following particulars:—The ground-colour is pale sulphureous and not whitish, the black marginal borders to each wing are also wider and blacker; the wings beneath are pale sulphureous, and the markings are similar to those of *T. lacteola*, but more obsolete and somewhat obliterated.

Exp. wings 35 millim.

This is a well marked species of *Terias*, the wide black margin to the posterior wings rendering it very distinct. It has been compared with the large collection of Teriads in the British Museum and also with the rich collection of species in the collection of Mr. F. Moore.

152. *Dercas gobrias.*

Gonepteryx gobrias, Hewitson, Trans. Ent. Soc. ser. 3, vol. ii. p. 246. n. 5, t. xvi. fig. 1 (1864).

Not common.

153. *Appias nero.*

Papilio nero, Fabricius, Ent. Syst. iii. 1, p. 153. n. 471 (1793).

Not common in any place I have yet visited in North Borneo.

154. *Appias enarete.*

Pieris enarete, Boisduval, Sp. Gén. i. p. 480. n. 61 (1836)

Abundant on river-banks.

155. *Appias albina.*

Pieris albina, Boisduval, Sp. Gén. i. p. 480. n. 62 (1836).

156. *Appias leis.*

Catophaga leis, Hübner, Zutr. ex. Schmett. figs. 771, 772 (1832).

157. *Appias leptis*, var. *plana.*

Pieris leptis, Felder, Reise Nov. Lep. ii. p. 163. n. 136 (1865).
Appias plana, Butler, Trans. Linn. Soc. ser. 2, Zool. vol. i. p. 551. n. 1 (1877).

158. *Appias lea.*

Pieris lea, Doubleday, Ann. & Mag. Nat. Hist. xvii. p. 23 (1846).

Common.

159. *Appias aspasia.*

Papilio aspasia, Stoll, Suppl. Cram. t. xxxiii. figs. 3, 3 *c* (1790).

160. *Saletara nathalia.*

Pieris nathalia, Felder, Wien. ent. Mon. vi. p. 285. n. 40 (1862).

161. *Hebomoia borneensis.*

Iphias glaucippe, var. *borneensis*, Wallace, Journ. Ent. ii. p. 3 (1863).

162. *Nepheronia valeria.*

Papilio valeria, Cramer, Pap. Exot. i. t. lxxxv. A (1779)

163. *Nepheronia lutescens.*

Nepheronia lutescens, Butler, Cist. Ent. vol. ii. p. 431 (1879).

Subfam. Papilioninæ.

164. *Ornithoptera flavicollis.*

Ornithoptera flavicollis, Druce, Proc. Zool. Soc. 1873, p. 356. n. 3.

Wherever there are long narrow spaces in the forest open to full sunshine, such as broad paths or roads, or in the neighbourhood of large flowering shrubs and creepers, this splendid insect is frequently to be seen. The male usually confines himself to soaring and floating backwards and forwards; the female settles on the flowers, and sips them with flapping wings.

165. *Ornithoptera miranda.*

Ornithoptera miranda, Butler, Lep. Exot. i. t. i. (1869).

Not distinguishable from the last when flying.

166. *Ornithoptera Brookeana.*

Ornithoptera Brookeana, Wallace, Proc. Ent. Soc. ser. 2, vol. iii. p. 104 (1855).

One specimen taken only, and that curiously a female, captured hovering round flowers.

167. *Papilio noctis.*

Papilio noctis, Hewitson, Proc. Zool. Soc. 1859, p. 423, t. lxvi. figs. 5, 6.

168. *Papilio neptunus.*

Papilio neptunus, Guérin, Deless. Souv. Inde, ii. p. 69 (1843).

169. *Papilio memnon.*

Papilio memnon, Linnæus, Mus. Ulr. p. 193 (1764).

Abundant in the neighbourhood of orange-trees.

170. *Papilio helenus.*

Papilio helenus, Linnæus, Mus. Ulr. p. 185 (1764).

171. *Papilio nephelus.*

Papilio nephelus, Boisduval, Sp. Gén. i. p. 210. n. 24 (1836).

172. *Papilio polytes.*

Papilio polytes, Linnæus, Syst. Nat. ed. x. i. p. 460. n. 7 (1758).

173. *Papilio demolion.*

Papilio demolion, Cramer, Pap. Ex. i. t. lxxxix. A, B (1779).

174. *Papilio emalthion.*

Iliades emalthion, Hübner, Samml. ex. Schmett. (1816–36).

175. *Papilio antiphus.*

Papilio antiphus, Fabricius, Ent. Syst. iii. 1, p. 10. n. 28 (1793).

Abundant.

176. *Papilio Delessertii.*

Papilio Delessertii, Guérin, Deless. Souv. Inde, ii. p. 68, t. xvii. (1843).

177. *Papilio antiphates.*

Papilio antiphates, Cramer, Pap. Ex. i. t. lxxii. A, B (1779).

Seen frequently, but not often caught.

178. *Papilio sarpedon.*

Papilio sarpedon, Linnæus, Mus. Ulr. p. 196 (1764).

Abundant.

179. *Papilio mecisteus.*

Papilio mecisteus, Distant, Rhop. Malay. p. 361, fig. 108 (1885).

180. *Papilio telephus.*

Papilio telephus, Felder, Reise Nov. Lep. i. p. 64. n. 49 (1865).

181. *Papilio empedocles.*

Papilio empedocles, Fabr. Mant. Ins. ii. p. 10. n. 94 (1787).

182. *Papilio arycles.*

Papilio arycles, Boisduval, Sp. Gén. i. p. 231. n. 51 (1836).

183. *Papilio agamemnon.*

Papilio agamemnon, Linnæus, Mus. Ulr. p. 202 (1764).

P. agamemnon is very abundant, and it is impossible to distinguish the allied species from it until caught. These species with *P. sarpedon* are fond of settling in places on the mud of river-banks, where there is decomposed vegetable matter.

All the *Papilios* are fond of full sunshine, and most of them are bold flyers, and are not often caught, except when enticed by flowers. They are more generally seen on the edge of forest than anywhere else. *P. antiphus* is the slowest flyer I know in Borneo, flying slowly about in open clearings and the like, or even in sweet-potato fields if there are a few bushes about.

184. *Leptocircus curius.*

Papilio curius, Fabricius, Mant. Ins. ii. p. 9. n. 71 (1787).

The only one obtained was caught flying round a bush in flower on a river-bank in full sunshine.

Fam. **Hesperiidæ.**

185. *Badamia exclamationis.*

Papilio exclamationis, Fabricius, Syst. Ent. p. 530. n. 373 (1775).

186. *Choaspes chuza.*

Ismene chuza, Hewitson, Ex. Butt. iv. *Ism.* t. i. fig. 4 (1867).

187. *Zea Martini,* n. sp.

Wings above dark fuscous: anterior wings with seven discal, pale, semihyaline spots, situate two in cell, two beneath cell divided by the second median nervule, and three (smallest) in suberect series between end of cell and apex of wing: posterior wings with a more or less distinct, broad,

central, sinuated, greyish-white fascia, broadest and palest at abdominal margin and narrowing, darkened, and obsoletely terminating a little beyond middle of wing. Anterior wings beneath as above, but with a greyish suffusion near inner margin: posterior wings beneath with a broad central pearly-grey fascia extending from costal margin near apex to abdominal margin, the fascia being posteriorly distinctly waved and sinuate. Head and pronotum dark fuscous; abdomen greyish white, its base and apex dark fuscous; body beneath dark fuscous, the abdomen greyish white, with the apex dark fuscous.

Exp. wings 44 millim.

188. *Baoris moolata.*

Hesperia moolata, Moore, Proc. Zool. Soc. 1878, p. 843.

189. *Baoris chaya.*

Hesperia chaya, Moore, Proc. Zool. Soc. 1865, p. 791.

190. *Telicota mæsoides.*

Pamphila mæsoides, Butler, Trans. Linn. Soc. ser. 2, Zool. vol. i. p. 554. n. 5 (1877).

191. *Tagiades gana.*

Pterygospidea gana, Moore, Proc. Zool. Soc. 1865, p. 780.

192. *Erionota thrax.*

Papilio thrax, Linnæus, Syst. Nat. i. 2, p. 794. n. 260 (1767).

193. *Plesioneura alysos.*

Plesioneura alysos, Moore, Proc. Zool. Soc. 1865, p. 789.

194. *Kerana diocles.*

Nisoniades diocles, Moore, Proc. Zool. Soc. 1865, p. 787.

195. *Kerana gemmifer.*

Astictopterus gemmifer, Butler, Trans. Linn. Soc. ser. 2, Zool. vol. i. p. 555. n. 3 (1877).

196. *Astictopterus xanites.*

Astictopterus xanites, Butler, Trans. Ent. Soc. 1870, p. 510.

XXXIV.—*On the Microscopic Fauna of elevated Alpine Lakes* (600–2780 *metres above the Sea*). By Dr. O. E. Imhof *.

The geographical distribution of microscopic organisms presents a field in which persevering labour may still find a fruitful soil. As microscopic animals are for the most part inhabitants of the water, we must seek for our treasures especially in the larger and smaller water-basins. These we may group as temporary and permanent. The former are accumulations produced by great precipitations, which, however, again disappear in dry weather. The others consist of the persistent pools, ponds, lakes, and seas. Not only those of the latter group, but also those of the former harbour animal life during the time of their existence, and it is exactly in this direction that comprehensive investigations are most desirable, as these would show what animals survive the period of desiccation either in the developed state or as ova, what animals may be transported from one place to another by atmospheric currents, &c.

At present I leave out of consideration the geographical distribution of the microscopic fauna in the seas, and confine myself to the basins of fresh water. It may be mentioned in passing that the microscopic fauna of the sea also presents a fertile field of research, which has indeed only of late been again investigated with some energy. The improvement of the apparatus and of the methods of investigation are of especial importance. I have had the opportunity of collecting marine material by my improved methods, and always with good results. Thus in materials from the Baltic a number of microscopic organisms occurred the existence of which was previously unknown. (Among vegetable structures *Anabœna* and *Asterionella.*) Special value may be claimed for the proof that in the Baltic forms of animals and plants occur which are pretty generally distributed in our freshwater basins. As examples, I may mention two of my new species of Flagellata—*Dinobryon divergens* and *D. elongatum.* These two forms also occur in the lake of Zurich, where they sometimes occur in the spring and summer in quite enormous quantities, while their number in winter is very much reduced.

The permanent freshwater basins are of very different characters. Thus, for example, the peat-mosses display an abundant microscopic fauna. In Switzerland we find such

* Abstract of an address delivered on November 22, 1886, before the Naturforschende Gesellschaft in Zurich ('Zoologischer Anzeiger,' 3rd and 17th January 1887, pp. 13 and 33).

peat-mosses in different places, *e. g.* in the neighbourhood of Zurich, near the Katzensee; also near the Hüttwylerseen in the vicinity of the Untersee, the Bünzermoos in the Aargau, the peat-mosses near Einsiedeln, &c. A rich locality already indicated by me will be the extensive peat-mosses near the Lago di Varese in Upper Italy.

A peculiar character is possessed by the subterranean water-basins, such as are met with especially in Carniolia, Dalmatia, and North Africa. In connexion with these we must also mention the fauna of the mineral springs. I have already commenced special investigations upon the fauna of the peat-mosses and mineral springs, and propose to report upon them next year.

For four years (since October 1882) I have chiefly occupied myself with the microscopic animals of the smaller and larger lakes belonging to the pelagic and deep-water fauna. The lakes hitherto visited by me amount in all to about 130.

In my present communication I propose to fill up a gap, namely as to the microscopic fauna of *greatly elevated* lakes. Upon this subject we find only isolated statements in literature. Probably the oldest publication in connexion with it is to be found in the 'Denkschriften der schweizerischen naturforschenden Gesellschaft,' in the year 1845:—Vogt, *Cyclopsine alpestris*, collected on the Aar glacier at an elevation of 8500 feet, =2552 metres, above the level of the sea. Perty's work, 'Kleinste Lebensformen der Schweiz' (1852), contains the most extended observations upon microscopic organisms. Of Rotatoria, Perty names twenty-four species, which he met with principally upon the St. Gotthard, the Grimsel, the Gemmi, the Simplon, the Faulhorn, the Stockhorn, and the Sidelhorn. He also cites numerous Infusoria as inhabitants of the more elevated water-basins. In connexion with my present investigations the occurrence of *Dinobryon sertularia* upon the St. Gotthard and the Grimsel is particularly to be noted. In the celebrated 'Microgeologie' of Ehrenberg (1854) we find, on pl. xxxv. B, figures of animals of the high Alps, upon which Ehrenberg had in the previous year (1853) published a communication in the 'Monatsberichten' of the Berlin Academy. These organisms were obtained from the Weissthor Pass on Monte Rosa. There are six Tardigrada, three Rotatoria, and an Anguillulid from an elevation of 11,138 feet, =3344 metres, above the sea-level.

The first naturalist who particularly investigated the pelagic fauna of the Swiss lakes, and among these the elevated St. Moriz lake, was P. E. Müller, from Denmark, who was

occupied with the Entomostracan group of the Cladocera. In this lake of the Engadine he found only a single species, *Bosmina longispina.* This group of the Cladocera was investigated in 1877, as regards its Swiss representatives, by Lutz of Berne. The basins examined lie in the environs of Berne (500–600 metres above the sea-level); but Lutz also gives some particulars as to forms which he obtained at greater elevations. In lakes of the St. Gotthard Pass, at 1800 metres, *Sida crystallina*, *Bosmina longispina* and *B. lævis*, Leydig, and *Chydorus sphæricus*; on the Giacomo Pass, at 2400 metres, *Alona lineata* and *Chydorus sphæricus.*

From thirty-two, chiefly Italian, lakes, Pavesi has brought together remarkably abundant materials upon the pelagic fauna. Of these thirty-two lakes, three are more than 600 metres above the level of the sea:—Lago di Ledro (669), *Ceratium longicorne*, *Bosmina longispina*, and *Cyclops brevicornis*; Lago di Alleghe (976), *Simocephalus vetulus, Daphnia pulex, D. longispina, Cyclops brevicornis, C. serrulatus*, and *C. gigas*, Lago di Ritom, *Vorticella* sp., *Simocephalus vetulus*, *Daphnia pulex*, *Cyclops brevicornis*, *C. serrulatus*, and *Diaptomus castor.*

Lastly, Asper, in his publications on the pelagic and deep-water fauna, has given some statements as to microscopic forms of animals. Thus, in the Klönthal lake (804 metres) he found a *Daphnia* and a Calanid, in the Silsersee a *Daphnia* and a Cyclopid, and in the lakes near the hospice of St. Gotthard (2114 metres) a *Daphnia* and some Calanids.

Of similar investigations beyond the borders of Switzerland we have to note the following:—

By Brandt, in the Alpine lakes of Armenia—Goktschai (1904 metres), several species of *Cyclops*; Tschaldyr (1958 metres), *Daphnia hyalina, Bythotrephes longimanus, Leptodora hyalina*; by Wierzejski, in the lakes of the Tatra; and by Zacharias, in the two Koppenteichen (1168 and 1218 metres).

Methods of investigation.—As there are generally no boats on the more elevated lakes, and it would be too expensive to carry a boat about with one to a great number of lakes unless it were very light and divisible, we must avail ourselves of other methods. The simplest method is to throw out the net, which, with some practice, may be done to a distance of 10 metres or more; but in this case one always runs the risk that the net, when allowed to sink, may become entangled. The loss of the net may be avoided by screwing it on to a divisible rod. I employ my alpenstock, to which two some-

what thinner rods of the same length can be attached. Another method is that which I have already described *, by means of a float to which the net is attached by a cord of any desired length, and with this one is able to fish a lake throughout its whole extent. Upon this method is founded another kind of investigation, by which we are enabled, *without a boat*, to bring up from the middle of the lake, and *from exactly measurable depths*, samples of mud with their inhabitants. Thus a small float is drawn out upon the cord stretched over the surface of the water, either to its middle or to any spot that may be selected for examination. The cord is then drawn tightly to both shores and fixed. The float has in the middle an aperture somewhat larger than the transverse measurement of my mud-scoop, which has already been described †. Over the aperture a pulley is attached to an upright bar, and over this runs a cord to which the apparatus is attached. When the mud-scoop, which is lowered from the shore, has touched the bottom it is drawn up again, and then the float with the apparatus is pulled to one shore, a sufficient quantity of line being let out at the opposite side.

I now pass to a selection from the results obtained in seventy-three freshwater basins elevated more than 600 metres above the sea-level, commencing in the east of my field of investigation. I have already reported upon the following elevated lakes in *Austria* :—The Offensee (646 metres), Fuschlsee (661), Krotensee (?), Vorderer Langbathsee (675), Grundlsee (700), Altausseersee (709), Schwarzsee (720), Zellersee (754), Vorderer Gosausee (909), and Plansee (977).

In Upper Bavaria I investigated sixteen elevated lakes in August and September 1884 and August 1885. Hitherto only Leydig and Weismann have published contributions to the knowledge of the vertical distribution of microscopic organisms in this region, which is so rich in lakes, and these relate to the Cladocera. My results as to the pelagic fauna are as follows :—

1. Staffelsee, 601 metres.—(Protozoa :) *Peridinium*, sp. ; *Ceratium hirundinella*, O. F. Müll. (Rotatoria :) *Anuræa intermedia*, Imh. (Cladocera :) *Daphnella brachyura*, Liév. ; *Daphnia*, 2 sp. ; *Bosmina*, sp. ; *Leptodora hyalina*, Lillj. (Copepoda :) *Cyclops*, sp. ; *Diaptomus*, sp.

2. Königsee, 603 metres.—(Prot.) *Dinobryon divergens*, Imh. ; *Ceratium hirundinella*, O. F. Müll. ; *Epistylis lacustris*,

* Zool. Anzeiger, no. 224.
† Sitzungsb. Akad. Wiss. Wien, 1885 (April).

Imh. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kellicott; *A. aculeata*, var. *regalis*, Imh.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnia*, 2 sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

3. Obersee, 603 metres.—(Clad.) *Daphnia*, sp.

4. Nieder-Sonthofersee.—(Prot.) *Ceratium hirundinella*, O. F. Müll.; *Vorticella*, sp. (Rot.) *Polyarthra platyptera*, Ehr.; *Anuræa longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, 2 sp.; *Diaptomus*, sp.

5. Alpsee (near Immenstadt), 664 metres.—(Prot.) *Dinobryon divergens*, Imh.; *D. elongatum*, Imh.; *Peridinium privum*, Imh.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia hyalina*, Leyd.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp. (Insecta) *Corethra* (larvæ).

6. Tegernsee, 726 metres.—(Prot.) *Dinobryon sociale*, Ehr.; *D. divergens*, Imh.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *A. aculeata*, var. *regalis*, Imh. (Clad.) *Daphnia*, sp.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

7. Bannwaldsee, 732 metres.—(Prot.) *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia*, sp.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

8. Hopfensee, 734 metres.—(Prot.) *Dinobryon divergens*, Imh.; *D. elongatum*, Imh.; *Peridinium*, sp.; *Ceratium hirundinella*, O. F. Müll.; *Vorticella*, sp. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *Euchlanis*, sp.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia kahlbergensis*, Schöd.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

9. Weissensee, 735 metres.—(Prot.) *Dinobryon divergens*, Imh.; *D. elongatum*, Imh.; *D. petiolatum*, Duj.; *Peridinium*, sp.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia*, sp.; *Leptodora hyalina*, Lillj. (Insecta) *Corethra* (larvæ).

10. Schliersee, 768 metres.—(Prot.) *Dinobryon sociale*, E r.; *D. divergens*, Imh.; *Ceratium hirundinella*, O. F. Müll.; *Peridinium tabulatum*, Ehr. (Rot.) *Anuræa longspina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella*

brachyura, Liév.; *Daphnia hyalina*, Leyd.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

11. Alpsee (near Füssen), 774 metres.—(Prot.) *Peridinium*, sp.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

12. Schwansee, 780 metres.—(Prot.) *Dinobryon elongatum*, Imh.; *Peridinium*, sp.; *Peridinium tabulatum*, Ehr. (Rot.) *Anuræa cochlearis*, Gosse; *Asplanchna helvetica*, Imh. (Clad.) *Daphnella brachyura*, Liév.; *Daphnia*, 2 sp.; *Bosmina*, sp.

13. Walchensee, 790 metres.—(Prot.) *Dinobryon divergens*, Imh.; *D. elongatum*, Imh.; *Peridinium privum*, Imh.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell. (Clad.) *Daphnia*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

14. Badersee, 830 metres.—No representatives.

15. Eibsee, 959 metres.—(Rot.) *Anuræa cochlearis*, Gosse; *A tuberosa*, Imh.; *Asplanchna helvetica*, Imh. (Clad.) *Leptodora hyalina*, Lillj.

16. Spitzingsee, 1075 metres.—(Prot.) *Dinobryon sociale*, Ehr.; *D. divergens*, Imh.; *D. petiolatum*, Duj., var.; *Peridinium tabulatum*, Ehr.; *Ceratium hirundinella*, O. F. Müll.; *Epistylis lacustris*, Imh. (Rot.) *Synchæta pectinata*, Ehr.; *Polyarthra platyptera*, Ehr.; *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Sida crystallina*, Müll.; *Daphnia*, sp.; *Scapholeberis mucronata*; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

Upon the deep-water fauna of a number of these lakes, and upon Bavarian lakes at a lower elevation, I will report hereafter.

On the microscopic animals from high Alpine lakes of Switzerland I have already published some statements with regard to the following:—Engstlensee, Seealpsee, Cavloccio, Lungino, and Sgrischus. The total number of lakes situated in Switzerland above 600 metres and hitherto investigated amounts to fifty-two. I give here in abstract the results obtained in some of them. The greater part (forty-five) belong to the Canton of the Grisons. Commencing with the

lakes occurring in other cantons, the following results may be indicated :—

1. Türlersee (Zurich; not belonging to the region of the Alps), 647 metres.—(Prot.) *Dinobryon sertularia*, Ehr.; *D. divergens*, Imh.; *Peridinium*, sp.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa cochlearis*, Gosse; *A. longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Sida crystallina*, Müll.; *Daphnia*, sp.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

2. Lungernsee (Unterwalden), 659 metres.—(Prot.) *Peridinium*, sp.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Sida crystallina*, Müll.; *Daphnia*, sp.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

3. Egerisee (Zug), 727 metres.—(Rot.) *Anuræa longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnia*, sp.; *Bosmina*, sp.; *Leptodora hyalina*, Lillj. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

4. Seelisbergersee (Uri), 753 metres.—(Prot.) *Peridinium*, sp.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Triarthra longiseta*, Ehr.; *Anuræa cochlearis*, Gosse: *Asplanchna helvetica*, Imh. (Clad.) *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.

5. Klönthalersee (Glarus), 804 metres.—(Clad.) *Daphnia*, sp.; (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

6. Seealpsee (Appenzell), 1142 metres.—In this lake the material was collected for me on July 24, 1885, by M. Heuscher with my apparatus. (Rot.) *Conochilus volvox*, Ehr.; *Anuræa aculeata*, Ehr.; *A. longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Bosmina*, sp. (Cop.) *Cyclops*, sp. *Asplanchna helvetica* especially occurred in enormous numbers of individuals.

7. Engstlensee (Berne), 1852 metres.—(Rot.) *Anuræa longispina*, Kell. (Clad.) *Daphnia*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus alpinus*, Imh.

Lakes situated in the Canton Graubünden :—

1. Cresta (near Flims), 830 metres.—(Clad.) *Lynceus truncatus* (captured in the region of the pelagic fauna). (Cop.) *Diaptomus*, sp.

2. Laaxersee (near Flims), 1020 metres.—(Clad.) *Daphnia*, sp.; *Bosmina*, sp.; *Lynceus*, sp. (Cop.) *Cyclops*, sp.

3. Davosersee, 1561 metres.—(Prot.) *Peridinium*, sp.; *Ceratium*

hirundinella, O. F. Müll. (Clad.) *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

4. Lower Arosasee, 1700 metres.—(Prot.) *Ceratium hirundinella*, O. F. Müll. (Clad.) *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

5. Upper Arosasee, 1740 metres.—(Prot.) *Dinobryon divergens*, Imh.; *Ceratium hirundinella*, O. F. Müll. (Rot.) *Polyarthra platyptera*, Ehr.; *Anuræa longispina*, Kell. (Clad.) *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.

6. St. Morizersee, 1767 metres.—(Prot.) *Ceratium hirundinella*, O. F. Müll. (Rot.) *Anuræa longispina*, Kell. (Clad.) *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

7. Campfersee, 1793 metres.—(Prot.) *Salpingœca convallaria*, Stein; *Ceratium hirundinella*, O. F. Müll.; *Stentor*, sp.; *Epistylis lacustris*, Imh. (Rot.) *Synchæta pectinata*, Ehr.; *Triarthra longiseta*, Ehr.; *Anuræa longispina*, Kell.; *Asplanchna helvetica*, Imh. (Clad.) *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

8. Silvaplana, 1794 metres.—(Prot.) *Ceratium hirundinella*, O. F. Müll. (Rot.) *Conochilus volvox*, Ehr.; *Anuræa longispina*, Kell. (Clad.) *Daphnia*, 2 sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

9. Silsersee, 1796 metres.—(Prot.) *Ceratium hirundinella*, O. F. Müll. (Rot.) *Conochilus volvox*, Ehr.; *Anuræa longispina*, Kell. (Clad.) *Sida crystallina*, Müll.; *Daphnia sima*; *Daphnia*, sp.; *Bosmina*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

10. Marsch, 1810 metres.—(Prot.) *Ceratium cornutum*, Ehr. (Rot.) *Anuræa longispina*, Kell.; *Euchlanis lynceus*, Ehr.; *Floscularia ornata*; the last two on the bottom. (Clad.) *Daphnia sima*. (Cop.) *Diaptomus*, sp.; *Heterocope robusta*, Sars.

11. Nair, 1860 metres.—(Rot.) *Anuræa longispina*, Kell. (Clad.) *Daphnia*, sp.: *D. sima*; *Lynceus*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus alpinus*, Imh.; *Heterocope robusta*, Sars.

12. God Surlej, 1890 metres.—(Prot.) *Ceratium hirundinella*, O. F. Müll. (Rot.) *Euchlanis*, sp. (Clad.) *Daphnia*, sp.; *D. mucronata*; *Lynceus*, sp. (Cop.) *Diaptomus alpinus*, Imh.

13. Weissenstein (north side of the Albula Pass), 2030 metres.—(Rot.) *Anuræa longispina*, Kell.; *A. aculeata*, var. *regalis*, Imh. (Clad.) *Daphnia*, sp.; *Lynceus*, sp. (Cop.) *Diaptomus alpinus*, Imh.

14. Viola, 2163 metres.—(Prot.) *Dinobryon sertularia*, var. *alpinum*,

Imh. (Rot.) *Polyarthra platyptera*, Ehr.; *Euchlanis*, sp. (Clad.) *Daphnia*, sp.; *Macrothrix*, sp.; *Lynceus*, sp. (Cop.) *Cyclops*, sp.

15. Nero (Bernina Pass), 2222 metres.—(Prot.) *Dinobryon sertularia*, var. *alpinum*, Imh.; *Peridinium*, sp. (Rot.) *Anuræa longispina*, Kell. (Clad.) *Daphnia*, sp. (Cop.) *Cyclops*, sp.

16. Bianco (Bernina Pass), 2230 metres.—(Prot.) *Dinobryon sertularia*, var. *alpinum*, Imh. (Rot.) *Polyarthra platyptera*, Ehr.; *Synchæta pectinata*, Ehr.; *Anuræa longispina*, Kell. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

17. Crocetta (Bernina hospice), 2307 metres.—(Prot.) *Dinobryon sertularia*, var. *alpinum*, Imh. (Rot.) *Polyarthra platyptera*, Ehr.; *Synchæta pectinata*, Ehr.; *Anuræa longispina*, Kell. (Clad.) *Daphnia*, sp. (Cop.) *Cyclops*, sp.

18. Gravasalvas (between Piz Lagreo and the crown of the pass of the Julier), 2378 metres.—(Rot.) *Anuræa longispina*, Kell. (Clad.) *Lynceus*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus alpinus*, Imh.

19. Nair (to the north of the Silsersee), 2456 metres.—(Rot.) *Anuræa longispina*, Kell. (Cop.) *Diaptomus alpinus*, Imh.

20. Motta rotonda (south of the Piz Gravasalvas), 2470 metres.—(Clad.) *Macrothrix hirsuticornis*; *Lynceus*, sp. (Cop.) *Diaptomus alpinus*, Imh.

21. Margum (above Sils-Maria), 2490 metres.—(Clad.) *Daphnia*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus alpinus*, Imh.

22. Materdell, 2500 metres.—(Rot.) *Polyarthra platyptera*, Ehr. (Cop.) *Diaptomus alpinus*, Imh.

23. Lower Raveischgsee (on the Sertig Pass, Bergün-Davos), 2500 metres.—(Clad.) *Daphnia*, sp.

24. Tscheppa (between Piz Lagreo and Piz Polaschin), 2624 metres.—(Rot.) *Anuræa longispina*, Kell. (Cop.) *Cyclops*, sp.; *Diaptomus alpinus*, Imh.

25. Sgrischus (on the Piz Corvatsch), 2640 metres.—(Rot.) *Anuræa longispina*, Kell. (Cop.) *Cyclops*, sp.

26. Furtschellas (on the Piz Corvatsch), 2680 metres.—(Clad.) *Daphnia*, sp. (Cop.) *Cyclops*, sp.; *Diaptomus alpinus*, Imh.; *Heterocope robusta*, Sars.

27. Prünas (south of the Piz Languard), 2780 metres.—(Cop.) *Cyclops*, sp. (in the upper lake); *Diaptomus alpinus*, Imh. (in the lower lake; these two lakes were formerly a connected water-basin).

Lastly, I have to add the results from two elevated *Upper Italian* lakes, both situated near the Swiss borders:—

1. Palu (in the Val Malenco, south of the Muretto Pass), 1993 metres.—(Prot.) *Ceratium hirundinella*, O. F. Müll. (Rot.) *Conochilus volvox*, Ehr.; *Anuræa longispina*, Kell. (Clad.) *Lynceus*, sp. (Cop.) *Cyclops*, sp.

2. Tempesta (in the Val Brutto in passing towards Poschiavo, on the Piz Scalino), 2500 metres.—(Prot.) *Dinobryon sertularia*, var. *alpinum*, Imh. (Rot.) *Anuræa longispina*, Kell. (Cop.) *Cyclops*, sp.; *Diaptomus*, sp.

General Results.

The great majority of the freshwater basins investigated up to 2000 metres elevation harbour a pelagic fauna very rich in individuals. In some of the lakes situated at a still higher level I also met with an enormous number of microscopic animals, as, for example, in the lakes of the Bernina Pass:—Nero, Bianco, Crocetta (2307 metres). Still higher up the result in this respect was surprising in the smaller water-basins of the Upper Engadine:—Margum, Tscheppa, Sgrischus, and Furtschellas (2680 metres). In some of them a *Daphnia* was particularly numerous, in others *Diaptomus alpinus* was represented in remarkable numbers.

From the tabular summaries drawn up we get the following remarkable results:—

Up to a height of 1796 metres (Silsersee) from seven to sixteen species appear usually in each lake. The higher we go up the smaller becomes the number of species inhabiting the open water.

As the most widely and generally distributed we find representatives of the genera *Daphnia*, *Cyclops*, and *Diaptomus*. The genus *Bosmina* occurred up to a height of 1908 metres (Cavloccio). *Bythotrephes longimanus* is wanting in the lakes above 709 metres (Altausseersee). *Leptodora hyalina* occurs in almost all lakes up to 1075 metres (Spitzingsee). *Daphnella brachyura* is ascertained only up to a level of 780 metres (Schwansee).

Among the Rotatoria the general distribution of *Anuræa longispina*, which has already been noted, is to be mentioned (highest lake, Sgrischus, 2640 metres). *Polyarthra platyptera* and *Synchæta pectinata* are met with here and there up to considerable elevations, the former in the Materdell, 2500 metres, the latter in Crocetta, 2307 metres. *Asplanchna helvetica* in nearly all lakes up to 774 metres (Alpsee,

Füssen), and here and there still higher—Spitzingsee, Seealpsee, Campfer (1793 metres).

Among the Protozoa *Ceratium hirundinella* is widely and very generally distributed up to 1993 metres (Palü), *Peridinium* up to 2222 (Nero). Species of the genus *Dinobryon* (especially *D. divergens*) exist in very many lakes up to an elevation of 1740 metres (Upper Arosa lake). From still more elevated lakes within a limited geographical region we have to note a variety, *alpinum*, of *D. sertularia* ([Poschiavo, 962], Viola, Nero, Bianco, Crocetta, and Tempesta, 2500 metres), colonies of which were captured in the above-mentioned lakes, sometimes in considerable numbers.

Finally, we have to note among the Copepoda the remarkable occurrence of *Heterocope robusta* in the lakes Marsch, Nair, and Furtschellas (2680 metres), all three in the Upper Engadine.

XXXV.—*Description of* Chondrosia spurca, *n. sp., from the South Coast of Australia.* By H. J. Carter, F.R.S. &c.

Chondrosia spurca, n. sp.

Specimen massive, irregularly cuboidal and nodular; broadly sessile where it appears to have been cut off by the dredge; nodules or round projecting parts of the surface covered with a smooth skin, followed inwardly by more or less fleshy substance, which, on becoming attenuated, traverses in all directions a mass of coarse detritus composed of fragments of shells, corals, gravel, sand, &c., that give it general solidity. Texture fleshy and homogeneous where devoid of foreign bodies; gritty in the rest of its composition. Colour yellowish drab. Surface sleek, smooth, slippery, uneven, more or less puckered in growth here and there; apparently without any opening at all in some parts, poriferous in others, pierced by vents here and there. Pores in tracts here and there, simple, or in the interstices of a well-pronounced fibro-reticulation. Vents of different sizes, on a level with the surface, scattered irregularly more or less in groups. Structure, commencing from without inwards, consisting of fine fibrillous tissue, so homogeneous in appearance throughout as to present no distinction in colour or composition between the surface and the interior beyond increasing compactness, which

ends in giving to the former its characteristic smoothness—that is, not corticate; charged internally with ampullaceous sacs (more or less indistinct now from defective preservation), varying in shape from circular to pyriform, probably according to their position, accompanied everywhere by globular, light-refracting, transparent, fatty-looking bodies in great abundance, especially towards the surface, but with no separate groups of pigment-bearing granules, as seen in *Chondrosia reniformis* &c.; traversed throughout by the water-vascular system, which, towards the surface, presents the usual inflations or *lacunæ* that, in a smaller form and in line just under the skin, in some parts, represent the so-called "subdermal cavities," into which the pores immediately over them empty themselves by short canals. The glary, light-refracting, cell-like bodies may be single and spherical or grouped in different degrees of duplicate subdivision, regular or irregular in size, altered from their globular form only by becoming flattened where in contact with each other; they are all more or less filled with daughter-cells, which from the transparency of the mother-cells can easily be seen within them; thus the glary bodies appear to increase by fissuration as well as by endogenous development; the daughter-cells also vary in size, but for the most part present themselves under the form of minute granules which, by reflected light, appear to be of the same composition as the mother-cells, but by transmitted light assume a dark brown colour, under which circumstances they present the appearance of the brown pigment granules of *Chondrosia reniformis* &c.; thus it is the surface of these granules in the latter case which becomes brown. The glary bodies are the most striking elements in the composition of the internal structure from their great abundance, being incomparably more numerous than in *Chondrosia reniformis* and almost indistructible, since, with the exception of iodine, which gives them a light amber tint, they are not only unaffected by acids or alkalies but, short of actual burning or putrefactive decomposition, appear to remain almost unaltered, as drying and mounting a thin microscopic fragment in balsam, accompanied by much heat, testifies. They have been faithfully described and illustrated by Schultze in *Chondrosia reniformis* ('Zeitschrift f. wiss. Zoologie,' Bd. xxix. pp. 20, 21, Taf. viii. figs. 9, 10), to which I must refer the reader for further observations on them. Of course there are no spicules but those which are of *foreign* origin. Size of specimen 3 inches high by 5 × 5 inches horizontally.

Hab. Marine; growing over, in, and amongst marine detritus.

Loc. Port Phillip Heads, south coast of Australia.

Obs. This specimen I omitted to notice in my "Supplement" to the descriptions of Mr. Wilson's sponges ('Annals,' 1886, vol. xviii. p. 271 &c.), as I had not time then to examine it before sending it with the rest of these sponges to the British Museum, so left it in an undetermined state, suggesting that it might be a "Synascidian." On going over the specimens at the museum, however, Mr. Ridley noticed that it was not a Synascidian but a sponge, and therefore sent it back to me for further examination, whence the above description, in which it is shown to be one of my order "Carnosa," or fleshy sponges, viz. a *Chondrosia.*

It differs from Schmidt's *Ch. plebeja* ('Spongien Küste von Algier,' p. 1) notwithstanding the presence of foreign material, and from Dr. Lendenfeld's *Ch. Ramsayi* (Proc. Linn. Soc. N. S. Wales, vol. x. pt. 1, p. 147, pl. iii.), as may be seen by comparing the descriptions respectively. At the same time all these species appear to me to be so nearly allied that it is difficult to say how far their differences are of any real specific value. It has been designated "*spurca*" on account of its uncleanly habit of enclosing marine detritus of every kind in its way, and to such an extent as to amount to much more in the present instance than half the bulk of the specimen itself. If I might be allowed to compare the "glary bodies" in this species to anything in the vegetable kingdom it would be to the chlorophyll-cells in plants.

P.S.—I have just found out from a preparation mounted in glycerine that the specimen to which I have alluded in my description of "*Halisarca reticulata*" ("Supplement," *l. c.* p. 274) as being charged towards the base with "small ova" is also charged throughout with the "glary bodies" undergoing multiplication, similar to those of *Chondrosia spurca*, and that they are so thickly congregated around the interstices of the fibro-reticulation of the surface as to constitute a distinctive character, which is continued inwardly along the surface of the canals opening through these interstices respectively; hence it becomes still more evident that this form will have to be made the type of a new species or genus, as I suggested in the concluding part of the description of "*Halisarca reticulata*" to which I have referred.

XXXVI.—*Descriptions of new Coleoptera in the British Museum.* By Charles O. Waterhouse.

Lucanidæ.

Dorcus suturalis, Westwood.

Three males and two females of this interesting species have recently been received from Major Yerbury, who collected them at Campbellpore. The female has not, I believe, been described. It somewhat resembles the female of *D. musimon*, but is of course larger (13 lines long) and is a little less parallel. The head is very rugose, with two very slight frontal tubercles. The thorax is shining, with some fine punctures scattered on the surface; there are some deeper punctures at the sides, which at the hind angles are close together; there are also a few large punctures on each side of an extremely shallow impression on the disk. The elytra are nearly as in *D. musimon*, but there is a somewhat broad smooth sutural area, owing to the first and third striæ being much reduced and consisting of comparatively fine punctures; the second stria is represented by some fine irregularly-placed punctures; the interval between the third and fourth striæ is broad, with some very fine scattered punctures.

Cetoniidæ.

Pœcilopharis Woodfordi, n. sp.

Oblonga, parallela, viridi-æenea, cupreo tincta, nitida; thorace lateribus parce fortiter punctatis; elytris sat fortiter striato-punctatis, maculis nonnullis vix perspicuis flavescentibus ornatis, lateribus postice transversim striolatis; tibiis anticis dentibus tribus approximatis parallelis armatis.

Long. 23 millim.

This species is allied to *P. uniformis*, Waterh. (Ann. & Mag. Nat. Hist. 1884, xiii. p. 370), which has the three apical teeth of the anterior tibiæ equidistant and parallel to each other. The tibiæ themselves are narrow and parallel, obliquely wrinkled and strongly punctured. The head is very finely sculptured, with some large punctures on the forehead; the female has some punctures at the side of the clypeus, which has the anterior margin nearly straight. The thorax has a few large punctures on each side of the disk and more at the sides. The seven lines of punctures on the elytra are

rather strong; the first, second, and third lines extend nearly to the apex; the second is very irregular and does not reach the scutellum. The pygidium is rather closely and finely striolate, with two obscure yellowish spots on each side.

Hab. Fauro Island, Salomon Islands (*C. M. Woodford, Esq.*).

Buprestidæ, n. sp.

Philanthaxia dorsalis.

Lata, convexa, nitida, aureo-viridis; elytris striatis, plaga magna cyanea ornatis.

Long. 9, lat. 4 millim.

Head densely punctured; the punctures moderately large but not deep. Thorax broadest at the posterior angles, considerably narrowed in front, very convex in front, slightly impressed above the posterior angles; green, with a slight blue tint on the disk; densely punctured, but the punctures are very shallow and in part confluent, the intervals appearing like curved striolæ. Scutellum broad, concave, smooth. Elytra striated, the lateral striæ deep. The interstices near the suture are nearly smooth, the lateral ones transversely striolate; the scutellar region and the sides asperate. At the base there is a very deeply impressed transverse line. The underside is green, with blue reflections; closely and moderately strongly punctured; the prosternal process less strongly punctured than the metasternum; the punctuation somewhat confused.

Hab. Java (*J. C. Bowring, Esq.*).

Engycera Cumingii, n. sp.

Sat angusta, convexa, subopaca, supra brunneo-cuprea, subtus griseo-nigra; capite antice viridi.

Long. 7, lat. 3 millim.

Somewhat intermediate in form between *E. œnea* and *E. purpuriceps*, gradually becoming broader from the head to the posterior two thirds of the elytra, and then obliquely narrowed to the apex. Head rather large, densely and finely rugosely punctured. Thorax at the base about one third broader than the length, convex, densely and rather roughly punctured; with a very slight impression on each side; the sides gently sinuate before the posterior angles. Elytra strongly striated, the striæ of nearly equal depth, but (as in *E. purpuriceps*) not reaching the apex; the interstices scarcely

convex, densely and transversely rugose. The underside closely ocellate-punctate; the punctuation of the apical segments of the abdomen finer; the prosternum rather rugose.

Hab. Philippine Islands.

Phrixia vittaticollis, n. sp.

Elongata, angusta, nitida, aureo-viridis; thorace medio cyanescente, vitta utrinque læte cupreo-rufa ornato; elytris læte cyaneis, maculis nonnullis albo-tomentosis impressis.

Long. 12½ millim.

General form of *P. auricollis*, L. & G. Head green, densely punctured. Thorax a little shorter than in *P. auricollis*, a little enlarged before the posterior angles; the punctures on the disk are distinct and separated from each other, becoming closer and stronger towards the sides, and at the sides crowded. Scutellum green. Elytra dark blue, with a narrow border of green at the base and on the suture near the scutellum; moderately strongly striate-punctate, with punctures irregularly scattered over the interstices. There are four white spots on the third interstice, a small one on the fifth at the apex, three on the seventh interstice, and a small one on the shoulder. The apex of each elytron is truncate, the outer angle slightly prominent and acute. The underside is somewhat strongly punctured, the punctures distinctly separated from each other. There is a spot of white pubescence on each side at the base of each abdominal segment.

Hab. Philippine Islands.

Aristosoma? crassum, n. sp.

Olivaceo-æneum, parallelum, bene convexum, sat nitidum; thorace crebre fortiter punctato; elytris sat fortiter striatis, interstitio suturali postice sat elevato, parce punctato, interstitiis lateralibus fortiter punctatis, lateribus confertim asperato-punctatis; corpore subtus cuprascente; processu prosternali subtiliter parce punctulato, apice lævi.

Long. 10, lat. 4½ millim.

This species from its short, broad, convex form is quite unlike any other species with which I am acquainted. It somewhat resembles *Aristosoma* * *suturale*, L. & G., but is much more convex, and the elytra are less pointed at the apex. The head is convex, thickly punctured, with a lunate impression on the forehead. The thorax is very convex, not impressed on each side; the punctures are rather large and

* Thomson, Typi Buprest., Append. 1879, p. 24.

close together, crowded at the sides; the anterior angles are much deflexed and are not visible from above; the base is distinctly lobed in the middle. The scutellum is rather small, nearly equilaterally triangular, impressed in the middle. The elytra at the base are scarcely as broad as the thorax, nearly parallel for three quarters of their length; the striæ are rather unequally impressed, the interstices near the suture are sparingly punctured, but those on the disk are strongly and more closely punctured, the punctures near the shoulder transversely confluent. There are three well-marked foveæ at the base of each elytron, and a short stria near the scutellum.

I have placed this species in the genus *Aristosoma*, but I must point out the following characters, which might by some be considered of generic importance:—The suture between the first and second abdominal segments is distinct, whereas in *Aristosoma suturale* it is quite effaced in the middle. The lateral margin of the thorax (seen from beneath) is sharply keeled, the keel nearly reaching the anterior angle. The epipleural fold of the elytra terminates abruptly on a level with the posterior coxæ, and there is a distinct elongate impression below the shoulder.

Hab. South Africa (*Sir A. Smith*).

Armenosoma, n. g.

General characters of *Sphenoptera*, but approaching *Capnodis* in form. Antennæ opaque and thickly punctured, with a shallow impression on the sixth to eleventh joints. Thorax about one third broader than long, moderately convex, obliquely narrowed in front of the middle, deeply sinuate on each side of the base. Scutellum rather large and transverse, produced into a point at the apex. Elytra short, about twice as long as the thorax, as broad as the thorax at the base, obliquely narrowed at the apex, gently declivous posteriorly. Metathoracic episterna about one third longer than broad. Tibiæ rather long and slender. Tarsi narrow, the basal joint a little longer than the second.

I have carefully examined the antennæ of this insect, but am unable to distinguish the "pores;" they are no doubt in the shallow impressions above referred to, but the antennæ being thickly punctured they are not distinguishable. For this reason I at first supposed the pores to be "diffused," but on a close examination I have no doubt that the real affinity of the genus is with *Sphenoptera*.

Armenosoma atrum, n. sp.

Oblongum, atrum, sat convexum, supra confertissime subtilissime punctulatum.
Long. 8–12 millim.

Dull black. Thorax broadest in the middle, scarcely narrowed at the base, with some fine punctures scattered over the disk, more closely punctured at the sides; generally with a very shallow longitudinal impressed line in the middle. Elytra with some obscure striæ, the punctures which form them being elongate and linear. Middle of the prosternum shining, finely and sparingly punctured. Sides of the abdomen rather closely punctured, the first to fourth segments each with a smooth spot at the side. Tibiæ slender, tinted with coppery, beset with lines of short black setæ.

Hab. Cape of Good Hope.

Discoderes humeralis, n. sp.

Æneus; thorace inæquali; elytris unicostatis, humeris læte rufo-cupreis, regione scutellari cyanea, postice fasciis undulatis duabus albidis, apice fulvo-pubescente.
Long. 16 millim.

Head deeply longitudinally impressed, with short fulvous pile between the eyes. Thorax very broad, sloping down in front, declivous at the sides, very closely and finely punctured, with a small impression in front and a large shallow one behind the middle; each side has a large irregular impression which is pubescent in the middle, and outside this there is a shining flexuous ridge which forms a figure resembling a 5. There are two small spots of dark brown pile on each side of the disk. Scutellum smooth, gently concave, triangular. Elytra as broad as the thorax, narrowed about the middle and then much wider at one quarter from the apex. The shoulders are raised and slightly prominent, steel-blue beneath, coppery red above. Rather before the middle there are several whitish spots which form a kind of interrupted fascia; behind the middle there is a zigzag fascia, and another near the apex; the space between the bands is very dark brown.

Hab. Madagascar.

MASCHALIX, n. g.

General characters of *Amorphosoma*, but relatively much shorter and broader; thorax broadest just before the base, narrowed anteriorly. Elytra a little wider than the thorax,

parallel for two thirds of their length and then very obliquely narrowed to the apex, rather flat. There is no distinct epipleural fold, but at the base there is beneath the shoulder a short obtuse ridge, which forms the outer border to a cavity in which the knee of the intermediate leg is placed when at rest. This is somewhat similar in *Amorphosoma* but much less marked.

I propose this genus for an insect which I believe is well known, but for which I have been unable to find a name. In general outline it much resembles a large *Trachys*.

Maschalix latipennis, n. sp.

Lata, depressa, niger, hic et illic æneo-tincta; thorace inæquali, crebre punctato; elytris pube grisea variegatis, fascia ante apicem apiceque nigris.

Long. 13, lat. 6 millim.

Head brassy, moderately thickly punctured, with two smooth spots between the eyes, clothed with yellowish pubescence, which forms a small tuft above each eye. Thorax with a shallow, punctured, median impression, with a slight double swelling just above the front margin. Sides with a deep irregular impression, with two round brassy swellings in front. Scutellum moderately large and cordiform, convex, brassy. Elytra with the shoulders prominent, and with an elongate tuberosity between the shoulder and the scutellum. The suture near the scutellum is brassy; the discoidal region is irregularly punctured, the sides closely rugulose. The short silvery-grey pubescence gives a slightly mottled appearance. There is a small round spot at the side about the middle, and a rather broad fascia towards the apex of black pubescence; the apex itself is also black. The underside is shining; the prosternal process very coarsely punctured; the punctuation gradually becomes less strong on the metasternum and abdomen, the apical segment being nearly smooth. The sides of the sternum and episterna are coarsely rugulose.

Hab. Queensland.

Callipyndax, n. g.

General characters of *Amyia*, but much shorter and relatively broader. The prosternum is furnished with a "mentonnière" which is gently sinuate in the middle. The femora have a double series of distinct acute teeth beneath, more distinct than in *Amyia*. Tarsi very short; the basal

joint of the front and intermediate pairs not longer than the second joint; the basal joint of the hind tarsi about as long as the second and third together. Thorax twice as broad as long, angular at the sides. Elytra as broad as the thorax, scarcely one half longer than broad; horizontal on the back, declivous posteriorly; parallel at the sides, obliquely acuminate at apex; each elytron with a short obtuse costa. Abdomen with the suture between the first and second segments obliterated.

Callipyndax cupreiventris, n. sp.

Brevis, supra cyaneus, subtus cupreus; thoracis lateribus, elytrorumque dimidio apicali argenteo-griseo pilosis.

Long. 10, lat. 5 millim.

Forehead smooth and shining, tinted with violet; between the eyes there is in the middle a longitudinal rather strongly punctured impression. Disk of the thorax impressed at the base, conically raised in front, marked with numerous short, curved, confluent striæ; sides declivous and impressed. Scutellum moderately large, triangular, slightly concave, with a transverse ridge at the base. Elytra at the base covered with closely placed, short, curved, confluent striæ; clothed with very short black pile on the disk; the apical half finely punctured, clothed with silvery-grey pubescence. Prosternum æneous, rugose. Metasternum and abdomen bright coppery, smooth and shining in the middle and strongly punctured; the sides clothed with coppery-golden pubescence, leaving a smooth shining spot at the side of each segment.

Hab. Brazil.

Calandridæ.

Macrochirus Herveyi, n. sp.

Niger, nitidus; thorace vittis tribus rufo-castaneis ornato, lateribus subtiliter punctulatis; elytris rufo-castaneis, sutura maculisque duabus magnis (ad marginem conjunctis) nigris; pygidio medio castaneo. ♀.

Long. corp. 45, rostr. 19 millim.

Rostrum very thick, compressed; thickly punctured above, nearly smooth at the sides, but with a line of rather strong punctures. Thorax longer and rather less convex than in *M. prætor* or *M. spectabilis*, and much more shining; very finely and indistinctly punctured in the middle, finely punctured at the sides. Elytra rather less shining than the thorax; the striæ black; the two sutural interstices are black. There is

a large black oblique spot extending from the shoulder nearly to the sutural stripe. The second black spot occupies the apical half of the margin and is joined to the humeral spot on the sixth interstice and also on the margin. The pygidium is finely punctured at the base, more strongly towards the apex, the punctures well separated from each other. There are some reddish spots on the epimera, episterna, and sides of the abdomen.

This species somewhat resembles *M. spectabilis*, Dohrn (Stet. ent. Zeit. 1883, p. 362), in colour, but is at once separated by the form of the thorax and smooth surface.

Hab. Malacca. Presented to the British Museum by Mr. D. F. A. Hervey.

XXXVII.—*Descriptions of three new Species of Butterflies from Burmah.* By H. Grose Smith.

Ixias meipona.

Male.—Upperside. Anterior wings: apical half dark brown, basal half sulphur-yellow, irrorated near the base with black, the brown area crossed beyond and partly above the cell by a broad irregular transverse orange band, which extends into the cell at its upper angle. Posterior wings sulphur-yellow, with a rather broad dark brown margin, tapering towards the anal angle.

Underside. Sulphur-yellow, very sparingly irrorated with black. Anterior wings paler towards the inner margin, with a black spot at the end of the cell and another indistinct spot near the inner angle. Posterior wings with a smaller black spot on the upper discocellular nervule. Both wings with minute black spots on the margins at the ends of the veins.

Expanse $1\frac{5}{8}$ inches.

Hab. Burmah.

In the collection of H. Grose Smith.

Near *latifasciatus* of Butler, but smaller; the dark margins on the upperside of the posterior wings much narrower, and the underside is almost clear sulphur-yellow, instead of being densely irrorated.

Cethosia thebava.

Upperside. Anterior wings with the apical portion, costa,

and the upper part of the cell nearly to the base fuscous brown, the remainder being rufous. The cell is crossed by four light rufous lines, forming two quadrangular spots; a series of white angular lines on the margin, between which and the cell is a row of five white spots, the three uppermost linear, the other two broader, with dusky brown spots in the middle. Posterior wings rufous, broadly margined with fuscous brown, and a series of white marginal angular lines corresponding with those on the anterior wings.

Underside. Anterior wings light brown, tinged towards the base with red; the cell, the basal portion of which is red, is crossed by three black spots, centred with and surrounded by dusky white; the middle row of white spots is confluent, extends nearly to the inner angle, and is margined internally by a row of black markings. The marginal white angles on both wings are broadly defined and bordered on each side with black, with a white spot in the centre of each angle. Posterior wings light brown, red towards the base, with three dusky white bands, irregularly defined; in the interior of each band are irregular indistinct rows of black spots.

Expanse 3 inches.

Hab. Yendaw, Burmah.

In the collection of H. Grose Smith.

Amblypodia yendava.

Male. — *Upperside.* Lilac-blue, margins broadly dark brown.

Underside. Brown. Anterior wings with a spot on the middle of the costa; a transverse band of six spots, the first four curving outwards, the fifth further from the outer margin, the sixth in a line with the fourth; two spots in and one at the end of the cell, and a submarginal indistinct band. Posterior wings with ten basal spots and a central band of spots, of which the first two are distinct, the next four confluent, the seventh angulated, and the eighth on the inner margin elongated; a submarginal indistinct band; a black spot at the anal angle, above which and on each side of the tail is an irroration of silvery greenish blue.

Female violet-blue.

Expanse $2\frac{1}{4}$ inches.

Hab. Yendaw, Burmah.

In the collection of H. Grose Smith.

Near *Atosia*, but much larger, and the arrangement of the spots on the underside is quite different.

XXXVIII.—*Observations on Freshwater Sponges.* By Dr. A. Wierzejski*.

The notes on freshwater sponges, lately published in the 'Zoologischer Anzeiger' (nos. 238 and 239) by F. C. Noll and Dr. Vejdovsky, lead me to make the following observations:—

As regards the new species, *Spongilla glomerata*, Noll, described in no. 238, I adopt Dr. Vejdovsky's opinion, who considers it identical with *S. fragilis*, Leidy †.

M. Noll further states that he has found *Spongilla fluviatilis*, L. & K., with both smooth and tuberculate spicules, and even with the latter predominating, from which he thinks it may be concluded that *S. Mülleri*, L. & K., might only be a variety of *S. fluviatilis*, L. & K. Although among a great number of examples of *S. fluviatilis*, L. & K., which I have examined, I have never found a single one with tuberculate spicules, I will not cast any doubt upon the correctness of Noll's statement. Nevertheless I regard his supposition as inadmissible, as the above-mentioned species are very well distinguished from each other by well-marked characters which remain constant in whole series of forms. For reasons to be stated below I even esteem *S. Mülleri* to be generically distinct from *S. fluviatilis*.

It may also be mentioned in passing that Dr. Marshall three years ago expressed the opinion that forms with coating-spicules in the external envelope of the gemmules might pass over into forms with amphidisci in that layer. This supposition is supported chiefly upon the structure of the gemmules of *S. jordanensis*, var. *druliæformis*, Vejd. As early as the year 1884 I expressed doubts as to its correctness ‡. Now, in his most recent revision of the European Spongillidæ Dr. Vejdovsky has given up both his new species *S. jordanensis* and the new variety *druliæformis*—a hint that it is not advisable to found far-reaching hypotheses upon isolated discoveries.

Finally, I would call M. Noll's attention to the fact that he has formed an erroneous conception of the development of the gemmule-mass of *S. fragilis*. The individual gemmules of the mass are developed, not, as he states, by division from unusually large deposits within the cellular cortical layer, but from special deposits, as I proved in the year 1884, and

* 'Zoologischer Anzeiger,' no. 245, February 28, 1887, pp. 122–126.

† See 'Annals,' February 1887, p. 168.

‡ See 'Orozwoju paków gabek slodkowodnych europejskich tucziei o gad. *Sp. fragilis*, Leidy' (Krakow, 1884), p. 5.

as indeed is easily seen from the structure of the completely formed mass.

Passing to Dr. Vejdovsky's statements, I will, in the first place, venture to make some remarks upon his revision of the known European Spongillidæ *.

This naturalist accepts only eight species as so-called good species, and these he distributes in four genera. In my judgment the specific rank of *Euspongilla rhenana*, Retzer, must also be regarded as doubtful. It is indeed sufficiently characterized by the perfectly smooth coating-spicules bent at the ends; but I suspect that these structures are abnormal; for among the tuberculate coating-spicules of *Euspongilla lacustris*, I have often found perfectly smooth crooked ones of different lengths.

Moreover, I possess two forms with such unusually developed siliceous elements in the shell of the gemmule that upon this ground alone they might be designated as new species, if certain considerations did not witness in favour of abnormal development.

In my catalogue of the Galician species † I have cited the species *Ephydatia Mülleri*, L. & K., under the name of *Meyenia Mülleri*, chiefly on account of its histological structure, in which it differs from all the species known to me, and therefore merits being placed in a separate genus. Thus the soft body of this sponge consists of the histological elements and organs which have been well known since Lieberkühn's time, and of vesicular cells. The latter agree morphologically with the structures which have long been known in marine sponges, which O. Schmidt has described in two species of *Esperia*, and most appropriately compared with masses of soap-bubbles. Portions of tissue in which these are particularly accumulated remind us, as Vosmaer ‡ correctly remarks, of the vesicular connective substance of Leydig, and of the tissue of the mantle of the Tunicata. In *Meyenia Mülleri* they lie closely approximated, especially in the dermal layer, and arranged in several layers, more particularly in the neighbourhood of the oscula; but they are also to be met with throughout the mesoderm, where they occur in greater or less number in different periods of the life of the stock. In the fresh state they are limpid spheres, in which we always detect a round vesicle, the nucleus, and further minute, very brilliant granules in variable number, and different sized portions of a

* See 'Annals,' *loc. cit.*

† See "Ogabkach slodkowodnych galicyskich." Krakow, 1885. (Spraw. Kom. Fizyogr. Akad. Umieter, tom. xix.).

‡ Bronn, 'Klassen und Ordnungen,' Porifera.

contractile substance. They originate from nucleated parenchyma-cells by the development of a gigantic vacuole, the walls of which are chemically differentiated.

Their behaviour with different reagents is worthy of notice. A moderately strong solution of acetic acid, after acting for a short time, causes them to burst, when the contents imperceptibly disappear, and only the nuclear vesicle with traces of the excessively fine membrane remains. An interrupted galvanic current produces the same phenomenon. Ammonia added by drops under the covering-glass effects a remarkable alteration. A double vesicle is produced; the inner one occupies an excentric position, its walls show a folding, its contents remain hyaline. The same alteration of the vesicular cells is observed during the gradual decay of the sponge. Solutions of hyperosmic acid (1 per cent.) and nitrate of silver produce no perceptible change; but if the preparations are exposed to the light the vesicular cells treated with the former solution acquire a light brownish colour, those with the second remain limpid, and only the granules and swellings of the contractile substance adhering to the surface are blackened. By treatment with strong alcohol and 1 per cent. solution of chromic acid the alteration is most striking. As a rule double vesicles are produced; the inner presents very multifarious images; its contents appear sometimes finely granular, sometimes reticular, sometimes nodular, &c. Fine filaments are often seen stretched from the surface of the inner vesicle to the inner surface of the outer one. As a matter of course the great variation of the images corresponds to the different degrees of concentration of the solutions employed, also chiefly to the different stages of development of the vesicular cells and their varying chemical constitution.

The vesicular cells treated with alcohol and chromic acid very readily imbibe picrocarmine, and thus strike one at once in preparations. On the contrary, they prove very resistant to aqueous solutions of aniline colours.

Their behaviour towards Lugol's solution is also very characteristic. Thus, if examples taken from dried specimens are placed in water for a few minutes and then treated with this solution, the shrivelled vesicular cells immediately acquire a light chestnut-brown colour, while the other elements become yellowish. After the partial volatilization of the iodine the colour changes to violet or wine-red. If a stronger solution be employed a dark brown colour is obtained. Precisely similar results are obtained by treating alcoholic preparations with Lugol's solution, only the action is not so rapid, and the specimens must be allowed to lie longer in the water.

The nuclear vesicle lying at the surface does not acquire the characteristic iodine-coloration. Judging from this reaction with iodide of potassium we might suppose the presence of glycogen in the vesicular cells. But as when the preparations treated with Lugol's solution are heated the colour does not disappear, and the material in question appears to be insoluble in water, we must reserve the final decision until it has been converted into sugar. A test for amyloid gave negative results, as also for sugar.

Although the nature of the substance contained in the vesicular cells remains for the present unknown, their behaviour with iodide of potassium furnishes us with a means of at once recognizing *Meyenia Mülleri*, even in small fragments, by the characteristic coloration of the vesicular cells. The circumstance that the vesicular cells occur at all periods of the life of the sponge, and even take part in the development of the gemmules, and, further, that in the regeneration of the stock from the gemmules they appear immediately after the emergence of the contents, indicates distinctly that they have a not unimportant part to play. It may be that they store up reserve material, or that they furnish nutriment to the cells surrounding them, or produce a secretion of some kind; at any rate, however, they indicate a peculiar œconomy in *Meyenia Mülleri*, distinguishing it from all other species.

After this brief description of the histological peculiarities of this species I need hardly add that it ought to have a special position in the system of the freshwater sponges. Further, I would point out that by the generally triple arrangement of the amphidisci in the shell of the gemmules, by the extremely rare development of the sexual products, and finally by the usually tuberculate skeleton-spicules, it seems to be sufficiently separated from the other Meyeninæ.

I have still to make a brief remark upon the following statement of Dr. Vejdovsky. This naturalist states (Zool. Anz. no. 239) that he induced M. Petr to investigate the minute structure of the external envelope of the gemmules of various Spongillidæ, and that the latter had succeeded in demonstrating "that this envelope in most species shows *the same structure* that occurs much more distinctly in *S. fragilis*, *S. nitens*, and *Trochospongilla erinaceus*."

This result of M. Petr's I must characterize as perfectly correct, especially as, in my memoir published in 1884 (*loc. cit.* p. 27), the following passage occurs in the concluding remarks:—"The remarkable coating of the gemmules of *Sp. fragilis* (*Lordii*) and *Trochospongilla erinaceus* represents genetically the insignificant reticulation between the amphi-

disci of the species of *Meyenia* (*Ephydatia*), and in the same way that between the coating-spicules of the species of *Spongilla.* In both cases this tissue, consisting of air-chambers, acts as a hydrostatic apparatus, which has attained its most powerful development in the two European species—*Sp. fragilis* and *Trochospongilla erinaceus.*"

XXXIX.—*The Polyzoa of the Adriatic: a Supplement to Prof. Heller's 'Die Bryozoen des adriatischen Meeres,'* 1867. By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Concluded from vol. xvii. p. 271.]

[Plate IX.]

SCHIZOPORELLA, Hincks (*continued*).

Schizoporella vulgaris, Moll.

? *Lepralia Botterii,* Heller, Bryoz. d. adriat. Meeres, p. 30, pl. ii. fig. 4.
? *Lepralia Stossici,* ibid. p. 31, pl. ii. fig. 7.

I do not venture to refer Heller's two species noted above with certainty to the well-known *S. vulgaris* of Moll in the face of the figures which he has given of them; but his descriptions apply for the most part to the latter form, and I think it more than probable that we have only to do with a single species. The neck-like prolongation of the upper part of the zoœcium which is shown in the figure of *L. Botterii* is certainly not characteristic of *S. vulgaris*; but there is no reference to it in the diagnosis; the cells are described as "oval, moderately convex, smooth." The present species seems to be common in the Adriatic and could hardly have escaped notice.

Primary cell ovate, smooth, with an oval aperture occupying the upper part of the front, set round with spines, of which the one in the centre of the lower margin is taller than the rest, slender, and bent inward over the opening.

Range. Britain (chiefly south and west); Ireland (west coast); Naples; Madeira.

Schizoporella Cecilii, Audouin.

? *Lepralia Perugiana,* Heller, *op. cit.* p. 26, pl. ii. fig. 10.

I should unhesitatingly identify Heller's *L. Perugiana* with

the present species had he not described the oral sinus as being frequently occupied by a small avicularium *. No such structure has been noticed in the case of *S. Cecilii*; but the resemblance between his form and the latter is in other respects so striking that it would be difficult to regard them as specifically distinct.

Range. Britain (south-west coast and Channel Islands); Mediterranean; Australia; Queen Charlotte Islands: Red Sea and Japan (*fide* Waters).

Schizoporella discoidea, Busk.

In specimens from the Adriatic the small avicularium on the front of the cell is sometimes replaced by a long spatulate form. The dependent lateral appendages were not noticed.

Range. Britain (south and west and Shetland); Ireland (west coast); Algiers; Madeira.

Schizoporella sanguinea, Norman.

Of very common occurrence. Avicularia are frequently wanting altogether; when present they are rather small, suberect with a pointed mandible, placed close to the orifice on one side, about on a line with the lower margin, directed obliquely upward; or in the corner at the top of the cell on a line with the upper margin of the orifice, either on one side or on both. Occasionally two or three are present on the front wall of the cell. The cells are invested with a strong epithecal covering, and the surface of the zoarium has a bright and varnished appearance.

Range. Britain (south-west and Channel Islands); Naples; Madeira; Florida; Queen Charlotte Islands.

Schizoporella linearis, Hassall (unarmed var.).

A variety of this common species occurs which is quite destitute of avicularia; in other respects it seems to agree with the normal form. The species is included in Heller's list.

SCHIZOTHECA, Hincks.

Schizotheca fissa, Busk.

Range. Britain (south-west and Channel Islands); Ireland (west coast); Naples.

* "Durch ein kleines gelbes Zähnchen (avicularium) ausgefüllt."

Family **Escharidæ** (part.), Smitt.

Lepralia, Johnston (part.).

Lepralia foliacea, Ell. & Sol. (sp.), var. *bidentata*, M.-Edw. The variety is not mentioned by Heller.

Lepralia complanata, Norman. (Pl. IX. fig. 4.)

Membranipora Smittii, Manzoni, Bryoz. foss. Ital. Contr. iv. pt. 2, pl. iii. fig. 16.
Micropora complanata, Hincks, Brit. Mar. Pol. p. 175, pl. xxiii. figs. 8, 9.

This species is wrongly referred to the genus *Micropora* in my 'History Brit. Mar. Pol.' The cells are surrounded by strongly-marked raised lines, but they do not exhibit any of the essential characters of the *Membraniporinæ*. There is no depressed area; the structure is in all respects that of a typical *Lepralia*. The specimens from the Adriatic, which are in fine condition, resemble the form described by Manzoni from the Italian Tertiaries in having an elongate marginal callosity on each side, extending downwards for some distance from the inferior margin of the orifice. This is a striking feature, and there is scarcely a trace of it in British examples. The orifice exhibits the shape which is characteristic of the restricted genus *Lepralia*.

Range. Italian Tertiaries; Great Britain.

Smittia, Hincks.

Smittia trispinosa, Johnston, form *spathulata*, Smitt. (Pl. IX. figs. 3.)

Escharella Jacotini, var. *spathulata*, Smitt, Flor. Bryoz. pt. 2, p. 59, pl. x. fig. 200.

Zoœcia ovate, quincuncial, very moderately convex (not deeply sutured), punctured round the margin; surface granulous or roughened, in some states punctate, commonly invested with a lustrous epitheeal covering, no marginal lines; orifice (secondary) elongate, orbicular above, produced below into a pointed spout-like sinus; peristome much elevated, thin, rising into a prominent point on each side at the entrance of the sinus; two or three marginal spines; a central denticle, usually small and square-topped, on the primary margin within the sinus, and two lateral projections. *Avicularia* usually numerous and multiform; frequently a small one with pointed mandible immediately below the sinus or

occasionally within it; a very long subspatulate appendage, originating at the side of the orifice and stretching down two thirds or more of the cell, mandible of very delicate material, slightly spatulate; commonly on the opposite side of the cell, a very slender elongate avicularium of much smaller size, with an attenuated mandible; often a small form with very slender pointed mandible at the side of the orifice near the top, replaced sometimes by a pair (with triangular mandible) placed one on each side and directed inwards. *Oœcium* suborbicular, much depressed, thickly covered with small punctures, and with a smooth line round the base.

Professor Smitt has described this form from the Floridan seas, ranking it under his *Escharella Jacotini* (= *Smittia trispinosa*, Johnston) as a variety. I have taken the same view of it *; but I confess that an examination of specimens from the Adriatic, where it seems to be common, has somewhat shaken my previous opinion. *S. trispinosa* is undoubtedly a very variable species, but the present form seems to be differentiated from the type by characters of some significance. As it occurs in the British seas it is furnished with only two kinds of avicularium—one small and oval in shape, which is usually placed at the side of the orifice, though occasionally distributed irregularly and profusely over the zoarium, and the second larger, with an elongate triangular mandible variously situated. The var. *spathulata* is remarkable for the diversity of structure which the avicularian appendage exhibits; no less than two or three very distinct modifications occur, of which the most marked is the large spatulate form. This is present in great numbers and very materially affects the appearance of the species. The small avicularium, with very finely pointed mandible below or within the sinus, is also a notable character (Pl. IX. figs. 3, 3 *a*). The orifice in the specimens from the Adriatic differs in some degree from that of our British form, so far as I have observed it, being commonly more elongate. The oœcium is very much depressed, almost level with the general surface; the small group of somewhat pyriform openings in the centre of the front wall, which is so characteristic of the British form, is wanting, and the surface is thickly covered with minute punctures. It may be added that the yellow colouring of the crust by which the species can usually be distinguished at once, and which is not evanescent, is absent.

On the whole, it will probably be safer to refer the present form to *S. trispinosa*, of which it must be accounted a very

* Ann. & Mag. Nat. Hist. for October, 1884, p. 282, pl. ix. fig. 4.

distinct and curious variety. This species is not noticed by Heller, nor is it included in Waters's Naples Catalogue.

Range. Florida; Port Phillip Heads, Victoria.

Rhynchopora, Hincks.

Rhynchopora bispinosa, Johnston.

Range. Britain; Australia; South Australian Tertiaries.

Retepora, Imperato.

? *Retepora cellulosa*, Smitt.

Heller records *R. cellulosa* as occurring in the Adriatic; but judging from his brief description it is difficult to determine the form which he had in view. The only species contained in Dr. Pieper's collection I believe to be the true *R. cellulosa* of Smitt, which occurs both in the Scandinavian seas and in the Mediterranean. It is very desirable that this specific name, which has been variously applied by the earlier writers, should be used at last in a definite sense, and we cannot do better than restrict it to the present form which has been so thoroughly characterized by Prof. Smitt in his classical monograph on the Northern Polyzoa.

Family **Celleporidæ.**

Cellepora (part.), Fabricius.

Cellepora avicularis, Hincks.

Range. Britain; Arctic seas; coast of North America; Naples.

Cellepora sardonica, Waters.

Range. Naples.

Cellepora retusa, Manzoni, var. *caminata*, Waters.
(Pl. IX. fig. 5.)

Hab. Forming small globular masses on weed.

The form recorded by Waters in his Naples Catalogue under the name *C. retusa*, var. *caminata*, occurs in the Adriatic. He subsequently identified it with *C. costata*, MacG.*, and more recently has placed amongst its synonyms *C. globularis*, Bronn, and *C. rota*, MacG. I have not Manzoni's 'Castrocaro' paper, in which *C. retusa* is described, at hand, and accept the identification of the Naples and Adriatic form with it on Mr. Waters's authority. It seems to

* "Bryozoa from Aldinga, &c. South Australia," Quart. Journ. Geol. Soc. Aug. 1885, p. 303.

me doubtful whether MacGillivray's *C. costata* is the same thing. The description of the ovicell as "small" and "globular" could certainly not be applied with any accuracy to that of *C. retusa*, var. *caminata*. *C. rota*, MacG., is probably the present species; but judging from Manzoni's description and figures ('Bri. foss. del Mioc. d'Austr.' &c.), I should certainly not have suspected any very close relationship between it and *C. globularis*, Bronn. Of course if Mr. Waters were right in regarding them as the same species, Bronn's name must be adopted. The point must be left for future settlement. The present species belongs to the same group as *C. Costazii*, Audouin, and *C. incrassata*, Lamarck. The structure of the oœcium is very similar in all of them, and they all possess the raised aviculiferous processes on the sides of the orifice. In the present form there is an additional one on the lower margin, but it is frequently absent. There is also a stout mucro on each side of the margin between the anterior and lateral aviculiferous processes. The cells are large, erect, distinct, the walls punctured and furrowed longitudinally, and the large spatulate avicularia are very numerous.

Cellepora ? sp.

Zoarium erect, stem subcylindrical; *zoœcia* irregularly disposed, ventricose, erect, not prominent, surface smooth and dense, orifice suborbicular, slightly produced below into a small shallow sinus, peristome not elevated, somewhat thickened, on the lower margin a mucro (not usually much elevated), bearing on the summit a small *avicularium* with a very short subacuminate mandible; large spatulate *avicularia*, much expanded at the extremity and borne on a raised framework, scattered amongst the cells. *Oœcium* (?).

One or two small specimens only of this form have occurred. I am unable to identify it with any known species.

Suborder Cyclostomata.

There are few Cyclostomata in Dr. Pieper's collection, and none of any special interest. The following species are not recorded by Heller.

Family **Tubuliporidæ.**

Diastopora (part.), Lamouroux.

Diastopora patina, Lamk.

The *Diastopora patina* of Heller is the *Lichenopora radiata* of Audouin (sp.) *.

* In my 'Hist. Brit. M. Pol.,' p. 458, I have inadvertently identified Heller's species with the true *D. patina*.

Range. Britain; France, S.W.; North and Arctic seas; Mediterranean (Capri); Queen Charlotte Islands, North Pacific.

Diastopora sarniensis, Norman.

Range. Britain (south); Mediterranean (probably); Queen Charlotte Islands.

Family **Frondiporidæ.**

FRONDIPORA, Imperato.

Frondipora verrucosa, Lamx. (sp.).

Frondipora reticulata, Blainville, Busk.

So far as we can judge from Lamouroux's description and figures there would seem to be no important difference between his species and the *F. reticulata* of Blainville and others. If we examine a series of the common Mediterranean species we find specimens in which the fasciculi form distinct and separate projections, and others in which the fasciculated elevation is more or less continuous. In almost every specimen the latter condition exists to some extent; towards the extremities of the branches especially (though not exclusively) the fasciculi commonly form elongated prominences, whilst in other parts of the zoarium they appear as isolated protuberances; and specimens occur (undistinguishable in other respects from the above) in which the confluent or continuous arrangement of the fasciculi largely predominates. The zoœcium is reticulate or simple in habit.

Range. Mediterranean; Kamtschatka and Spitzbergen (according to Lamouroux).

Suborder CTENOSTOMATA.

Family **Alcyonidiidæ.**

ALCYONIDIUM, Lamouroux.

Alcyonidium gelatinosum, Linn.

Range. Britain; North and Arctic Seas; North America; Queen Charlotte Islands; Natal.

Alcyonidium mytili, Dalyell.

Range. Britain; Bahusia; Jan Mayen; Baltic Sea; Naples.

Family **Vesiculariidæ.**

BOWERBANKIA, Farre.

Bowerbankia imbricata, Adams, form *densa*.

Abundant, growing in dense subglobular tufts.
Range. Britain; White Sea; Caspian Sea; Roscoff.

Bowerbankia caudata, Hincks.

Range. Ilfracombe.

Bowerbankia biserialis, n. sp. (Pl. IX. figs. 6.)

Erect, stems * composed of stout, cylindrical, transparent internodes of great length; at each joint two opposite branches given off, the terminal internodes tapering off to a blunt point. *Zoœcia* oblong, of moderate size, and about equal width throughout, subtruncate above and rounded below, sessile, transparent, arranged in two distinct series, which originate in a central cell or group of cells near the base of an internode, from which they diverge and run along opposite sides of the stem in a double row, the intermediate portion of the stem destitute of cells.

Height of specimen about an inch and a quarter.

This is an interesting form, and is distinguished from every other known Vesicularian by the peculiar arrangement of the zoœcia. Towards the base of the internode a group of cells is developed, and from this as a starting-point proceed two divergent series of cells, which traverse the opposite sides of the cylinder, to the summit of the internode. Each series is composed of two lines of cells (at least), and after reaching the side of the cylinder they run parallel to one another (Pl. IX. fig. 6), a wide space, destitute of zoœcia, lying between them. The cell is very much smaller than that of *B. imbricata*, and altogether of more delicate make. The stem is comparatively thick and the internodes of great length, so that the branching appears scanty.

Bowerbankia pustulosa, Ellis & Sol.

? *Valkeria Vidovici*, Heller.

The true *B. pustulosa* occurs in the Adriatic, and I am inclined to think that Heller's species must be identical with it. The only difference between them, judging from his

* No doubt the erect shoots are developed on a creeping stolon; but in the only specimen which I have examined it was wanting.

figure, is that the groups of cells are more compact in *V. Vidovici*, and do not extend so far down the internode as in *B. pustulosa*. In this respect it agrees with *B. citrina*, mihi, a kindred form; but as no mention is made of the remarkable colouring which distinguishes this species, we have no sufficient ground for identifying them.

Family **Buskiidæ**, Hincks.

Buskia, Alder.

Buskia socialis, n. sp. (Pl. IX. figs. 7.)

Stem erect, slender, irregularly branched, branches long and straggling. *Zoœcia* developed in groups along the stem and branches, usually separated by intervals, but occasionally almost confluent, placed on different aspects of the stem so as to surround it, comparatively large, elongate, adherent for about a third of their length, rounded off at the lower extremity, the upper surface straight for some distance above it, the anterior portion suberect and free, and closed in below by a membranous area, which extends from the point of adherence to the oral extremity; one or two adherent spinous processes given off on each side of the cell just below the area; cell elongate-flask-shaped, when the tentacular sheath and setæ are exserted (see fig. 7).

B. socialis is a much larger species than *B. nitens*, Alder, but about the same size as *B. setigera*, which I have lately described from the Mergui Archipelago. It is distinguished from its congeners by its erect and branching habit, as well as by the form and grouping of its zoœcia. The latter are elongate and are placed lengthwise upon the stem, one following the other, but not on the same aspect of it. The decumbent and adherent portion seems to be longer than in either of the other species; the anterior part slopes gradually upward, expanding towards the oral extremity (Pl. IX. fig. 7 *a*). The whole of the front of the cell from the point of adherence is closed in by a membranous wall. On the lower part of the stem in the specimen examined the cells form a continuous line; but generally they are associated in groups of four or five, which are separated by a distinct interval. The adherent spines round the base of the cell, which are so characteristic of *B. nitens*, are represented here by one or two short spinous processes.

The three species of *Buskia* which are now known constitute a very good representation of the generic type.

Family **Cylindrœciidæ.**

Cylindrœcium, Hincks.

Cylindrœcium giganteum, Busk.

Range. Britain; Naples; Queen Charlotte Islands; Mergui Archipelago.

Family **Triticellidæ**, G. O. Sars.

Hippuraria, Busk.

Hippuraria verticillata, Heller (sp.). (Pl. IX. figs. 8.)

Valkeria verticillata, Heller, *op. cit.* (1867).
? *Lagenella nutans* (part.), Joliet, Bryoz. des côtes de France, p. 101 (1877).

There can be no doubt that the species to which Prof. Heller has given the above name belongs to this family. At the time when his work on the Polyzoa of the Adriatic was published G. O. Sars's admirable paper on the genus *Triticella* had not appeared, and the peculiarities of the type were really unknown. The species occurs abundantly in Dr. Pieper's collection on seaweeds.

The stem is altogether repent and jointed at intervals; below each joint the stem is somewhat enlarged and is flanked on each side by a nodular swelling, from which a branch is given off. At each joint a group of cells is placed (Pl. IX. fig. 8 *a*). The zoœcia are elongate-ovate, slightly curved outwards on one side, and on the other (the ventral) somewhat compressed and flattened. The ventral face is occupied by a membranous area, which extends from the top almost to the base of the cell, the orifice is terminal. The cells are borne on an extremely short peduncle, to which they are jointed, so as to secure a certain amount of mobility (Pl. IX. fig. 8).

The structure is altogether that of the *Triticellidæ*, and the species should probably be referred to the genus *Hippuraria*, in which the cells are aggregated in whorls (in the erect form) or in groups, as in the present case, round the nodular enlargements. In *Triticella* they are scattered singly along the stolon. It may indeed be a question whether this difference is of sufficient significance to warrant the separation of forms otherwise so closely allied; but if the genus *Hippuraria* is retained the present form must be referred to it.

The *Lagenella nutans* of Joliet obtained at Roscoff is

probably identical with Heller's species; and if so, his name must rank as a synonym *.

Group *ENTOPROCTA*, Nitsche.

Order PEDICELLINEA.

Family **Pedicellinidæ**, Hincks.

Pedicellina, Sars.

Pedicellina cernua, Pallas.

Range. Britain; North and Arctic Seas; White Sea; Roscoff; Naples.

Barentsia, Hincks.

Barentsia gracilis, Sars (sp.).

I have removed this species from the genus *Pedicellina* (in accordance with a suggestion made some time since †) on the ground of the localization of the muscular power concerned in the movements of the peduncle.

The form of *B. gracilis* in which the stem is much elongated, and carries one or two muscular enlargements in addition to the normal one at the base, occurs in the Adriatic ‡.

Family **Loxosomidæ**.

Loxosoma (? sp.).

A fine species occurs, clustering about a tuft of *Bugula*. The body large, rather elongate, ovate when the tentacles are retracted; buds numerous, forming two large clusters, placed on opposite sides of the body, sometimes as many as five (or more) in a cluster; stem of great length, and apparently simple at the base. The length of the stem and the profusion of the large clusters of buds are marked characteristics. The number of tentacles was not determined.

[? *L. Kefersteinii*, Claparède.]

* Joliet mentions a form as also occurring at Roscoff which is furnished with a peduncle almost equal to the cell in length; this he regards as a variety of *H. nutans*, but he supplies no sufficient description. In *H. verticillata* the peduncle is of very uniform length.

† "Contrib. Gen. Hist. Mar. Pol.," 'Annals' for May 1884.

‡ Mr. Lomas, in his Report on the "Polyzoa of the Liverpool Marine Biology Committee's District" (Proc. Lit. Phil. Soc. Liverpool," vol. xl. Appendix), distinguishes this form as var. *nodosa*.

Supplement.

Family **Membraniporidæ**.

Group *a*.

Flustra, Linnæus.

Flustra tenella, n. sp. (Pl. IX. fig. 1.)

Zoœcia in two layers, elongate, rectangular, narrow, margins thin and smooth, on each side a little below the top a single short acuminate spine. *Avicularia* distributed amongst the cells, placed obliquely on a small oblong area, ovate, broad and rounded below, tapering slightly upwards, elevated towards the upper (or mandibular) extremity, and depressed at the opposite end; mandible broadly triangular, bluntly pointed above. *Oœcium* small and shallow, depressed and covered by the membranous cell-wall, oral arch rather prominent; the opening closed in by a membranous curtain. *Zoarium* composed of very narrow segments, expanding slightly upwards, and bifurcating frequently; the terminal segments rounded at the extremity.

This is the form which in the earlier portion of this paper I referred to *F. securifrons*, Pallas; but further examination has shown me that it is in many important particulars very distinct from that species, and must be separated from it. *F. tenella* is of very delicate habit as compared with Pallas's species, the segments of its zoarium being very much narrower than those of the latter (only about a third of the width), and wanting altogether the broad wedge-like terminations that are so characteristic of *F. securifrons*. In shape the cells of the two forms are very similar, but those of *F. tenella* are furnished with a pair of spines near the upper extremity, which are altogether wanting in the other species (Pl. IX. fig. 1). The most striking differences, however, are found in the oœcium and avicularium. The oœcium in *F. securifrons* is ample, projecting a considerable way into the cell above it, whilst in the present species it is insignificant in size and very shallow; in the former the opening is protected by two curious rib-like appendages (Pl. IX. fig. 2), which originate one on each side and meet in the centre; in the latter these are wanting and the orifice is simply closed by the usual membranous curtain. The avicularium of *F. tenella* is large, always placed obliquely, with a bluntly pointed triangular mandible of considerable width; that of *F. securifrons* is smaller, with a comparatively short rounded mandible,

and is set straight in the line of the cells. [Compare Pl. IX. figs. 1 *a*, 2 *a*.]

I have only had the opportunity of examining small pieces of *F. tenella* and am therefore unable to give any account of its general *habit of growth* *.

Flustra pusilla, n. sp. (Pl. IX. fig. 9.)

Zoœcia in one layer, small, rounded above, the upper portion wide, narrowing off below, truncate at the base (occasionally running to a point), margin very thin, smooth, no spines. *Avicularia* distributed amongst the cells, numerous, situated on a small quadrate area, at the bottom of a cell, usually placed transversely, very regularly oval, slightly elevated at one extremity; mandible short, rounded at the top. *Oœcia* (?).

Dorsal surface of the zoœcia convex, smooth, sutures well-marked.

The only specimen which has occurred consists of a very small elongate segment attached to the stem of a seaweed.

F. pusilla bears a close general resemblance to *F. membranaceo-truncata*, Smitt, a common northern species; but the cells of the latter are much larger and more elongate than those of the present form, which approach the ovate type, whilst there is a striking difference between the avicularia (Pl. IX. fig. 9, compared with fig. 10). The specimen examined consists of a single lamina.

Group b.

Membranipora.

Membranipora tenuirostris, Hincks.

Range. Madeira; Naples; Queen Charlotte Islands.

[Section Amphiblestrum.]

Membranipora patellaria, Moll, form *multijuncta*, Waters.

Hab. On shell.

Range. Mediterranean (normal), *Moll*; form *multijuncta*, Naples; Victoria.

* The paragraph respecting *Flustra securifrons* in the early part of the paper must be cancelled, with the exception of the portion relating to the oœcium, which must be referred to the present species.

Family **Myriozoidæ** (part.), Smitt.

SCHIZOPORELLA, Hincks.

Schizoporella lineolifera, Hincks.

When I characterized this species in a former part of this paper I had overlooked the fact that it had already been described by Busk in his 'Challenger' Report under the name of *S. marsupifera* *. I have no doubt of the identity of the 'Challenger' species with the form from the Adriatic, and Mr. Busk's name must therefore supersede my own. I may add that he has not noticed the stellate character of the punctures on the cell-wall, which is due to the presence of a few very minute denticles within the margin. The shape of the orifice too as shown in the 'Challenger' figure differs from that which is met with in the specimens from the Adriatic. In the latter the operculum is rather broad and arched above, and narrows off gradually to a blunt point. The orifice should rather be described as produced and pointed than as distinctly sinuated.

Range. Marion Island, 50–75 fath., on *Fucus*; lat. 39° 32′ S., long. 171° 48′ E., 150 fath., blue mud; Adriatic, on *Fucus*.

Beania mirabilis, Johnston.

Heller mentions this species as occurring once on an Alga at Lesina; but Dr. Pieper informs me that it is common on Algæ, shells, sponges, &c.

He also states that *Valkeria Vidovici*, Heller (? *Bowerbankia pustulosa*), is one of the most abundant of the Polyzoa of the Adriatic.

In the present Report about forty species are enumerated which are not included in Prof. Heller's work. He has recorded one hundred and five species probably distinct, making a total of one hundred and forty-five for the Adriatic.

Of those now first recorded nine are new to science; of the remainder a few, such as *Chlidonia*, *Smittia trispinosa*, *Schizoporella marsupifera*, *Eucratea chelata*, &c., have a wide distribution, or at least have occurred at isolated points remote from one another. But a large proportion of them have much the same range—from Southern Norway (or, in the case of some, from the west and south coasts of England and Ireland)

* 'Challenger' Report, p. 165, pl. xxii. fig. 14.

to the Mediterranean and Madeira. A small number occur in the Arctic seas.

It may be convenient to identify as far as possible a number of Heller's species which are probably referable to forms already described when he wrote, and to note some of the changes in the generic names:—

Scrupocellaria capreolus, H.,=*S. Bertholletii*, Aud.; *Diachoris simplex*, H.,=*Membranipora patellaria*, Moll (sp.); *Membranipora bifoveolata*, H.,=*Micropora impressa*, Moll (sp.); *Lepralia cribrosa*, H., =*Crib. punctata*, var.; *Lepralia Kirchenpaueri*, H., ?=*L. adpressa*, Busk; *L. appendiculata*, H., ?=*C. marsupiata*, Busk; *L. Steindachneri*, H., = *Cribrilina Gattyæ*, Busk; *Eschara fascialis*=*Lepralia foliacea*, form *fascialis*; *Eschara cervicornis*, M.-Edwards, = *Smittia cervicornis*; *Discosparsa patina*, H., = *Lichenopora radiata*, Aud.; *Obelia tubulifera*, Lamx., = *Idmonea serpens* (young); *Valkeria verticillata*, H., = *Hippuraria verticillata*.

EXPLANATION OF PLATE IX.

Fig. 1. *Flustra tenella*, n. sp. 1 *a*. Avicularium.

Fig. 2. *Flustra securifrons*, Pallas. Zoœcia magnified, to show the rib-like appendages protecting the opening of the oœcium. 2 *a*. Avicularium.

Figs. 3, 3 *a*, 3 *b*. *Smittia trispinosa*, Johnston, form *spathulata*, Smitt. 3 *c*. Spatulate avicularium.

Fig. 4. *Lepralia complanata*, Norman.

Fig. 5. *Cellepora retusa*, Manzoni, var. *caminata*, Waters.

Fig. 6. *Bowerbankia biserialis*, n. sp. An internode and its zoœcia, magnified. 6 *a*. Portion of stem, showing a joint and the mode of branching.

Fig. 7. *Buskia socialis*, n. sp. One of the groups of zoœcia, magnified. 7 *a*. A single zoœcium. 7 *b*. Nat. size.

Fig. 8. *Hippuraria verticillata*, Heller (sp.). Zoœcia. 8 *a*. A portion of the stolon, with one of the nodular enlargements from which the groups of zoœcia originate.

Fig. 9. *Flustra pusilla*, n. sp. Group of zoœcia, with avicularia.

Fig 10. *Flustra membranaceo-truncata*, Smitt. Zoœcium with avicularium.

XL.—*On the Structure of the Pseudoscorpions.* By A. Croneberg *.

The circumstance that a small Pseudoscorpion, *Chernes Hahnii*, C. Koch, occurs pretty plentifully near Moscow

* From the 'Zoologischer Anzeiger,' no. 246 (March 14, 1887), pp. 147–151. A preliminary note.

under the bark of trees, led me to undertake as thorough an anatomical investigation as I was able to make of this representative of a group of animals which is still but imperfectly known. Besides the above-mentioned species I had at my disposal a few specimens of a rarer undetermined species of *Chernes*, as also of *Chelifer granulatus*, C. Koch.

The buccal aperture is on the lower surface of a rostrum which unites the basal joints of the maxillæ from above, and of which the anterior part consists of a nearly transparent chitinous membrane, which projects in the form of an elongate ovate upper lip. The margins of this lamella, which are folded downwards, are soldered together anteriorly in the middle line; but further back they separate from each other and are furnished here with a fine denticulation. In the space between them a second strongly boat-shaped compressed lamella is received like a lower jaw, and its margins are also finely denticulated. The whole in profile has a certain resemblance to a shark's tail. Posteriorly the two lamellæ pass over into the wall of the short pharynx, which is situated immediately beneath the basal part of the rostrum. The strongly chitinized wall of the pharynx is produced into four ridges, so that the narrow lumen has a four-rayed transverse section. Numerous muscles which extend partly between the ridges of the pharynx and partly between the latter and the walls of the body serve as dilators, while the contraction of this sucking-apparatus appears to be left to the elasticity of its walls.

Its posterior extremity abuts directly upon the central mass of the nervous system, which in nearly all the conditions of both external and internal structure resembles that of certain Acarida (*Eylaïs, Trombidium*)—a spherical brain seated upon a broad, quadrangular, thoracic ganglion; but I could not observe anything of the fine accessory nerves of the extremities which occur in many Arachnida. On the other hand, in *Chernes*, which, as is well known, is blind, there are a pair of fine nerves at the same part of the brain from which the visual nerves originate in the above-mentioned Acarida. The thickness of the nerve-cell layer around the inner granulo-fibrous substance in the whole of the cephalothoracic ganglion is also remarkable. The cephalothoracic ganglion is traversed by a very narrow œsophagus, which enlarges in the form of a funnel immediately behind the brain, and then at once narrows again to form the intestinal tube. This small dilatation forms the true stomach of the animal; like the intestine, it is lined with a clear small-celled epithelium, and communicates directly with three great hepatic sacs, two

lateral and one inferior, unpaired, which form the great mass of the viscera. The two lateral sacs again divide on the outside each into eight secondary lobes, between which the vertical abdominal muscles traverse the body-cavity, while the straight median margins meet in a shallow longitudinal furrow, in which the heart lies imbedded. The divisions of the liver are held together by a cellulo-vesicular connective tissue, which is particularly developed on their distal segments, but also occurs around the other viscera.

The unpaired inferior hepatic sac only has slightly undulated contours and extends into the last third of the abdomen, beneath the genitalia, by the efferent ducts of which it is embraced anteriorly. The inner lining consists of large cells densely packed with granules and oil-drops; among their brown contents small accumulations of a chalky-white substance show themselves very distinctly, giving the whole organ the appearance of being closely sprinkled with white; larger portions of the same substance also form the exclusive contents of the intestine. It is interesting to see how this white excretion, which in the Hydrachnida and Trombidida forms exclusively the residue of the digestive process, does not appear in the Pseudoscorpions enclosed in a canal-system with proper walls separated from the liver, while in the Hydrachnida such a system occurs in all transitions from a widely branched excretory tube (*Eylaïs*) to a massive unpaired one (*Hydrachna*) which is applied to the wall of the stomach, and, as I have shown, opens into the anus, in continuity with which it can be separated from the cæcally closed stomach. In Pseudoscorpions, as Menge correctly states, the intestine forms a double loop, and opens by a dilated rectum into the anus.

Like Daday, I find the heart extending from the fourth ventral segment up to the brain; the posterior half possesses a musculature arranged in numerous transverse segments, while the lighter anterior portion, representing an aorta, divides into two branches just behind the brain. In *Chernes* the fissures (four pairs) occur only in the posterior, slightly dilated end of the heart, on which on each side a muscular fibre breaking up into several branches is inserted.

In both sexes the genitalia open at the base of the abdomen between two transverse chitinous plates, representing the second and third abdominal segments, not, however, with two apertures, as Menge thought, but with a single unpaired orifice. The testes in *Chernes*, as also in *Obisium*, have a form resembling that of the ovaria of the scorpion or the genitalia of *Eylaïs*, inasmuch as they consist of three longi-

tudinal canals (a median and two lateral ones), which are united to each other by transverse canals; the meshes of the testes, as in *Eylaïs*, embrace the diverticula of the liver. In *Chelifer*, however, the testis, as quite correctly described by Menge, has the form of a simple median tube. From this, as also in *Chernes*, originate two anterior divergent *vasa deferentia*, which embrace the median hepatic sac and pass over into a complicated unpaired terminal segment. This forms first a strongly muscular spherical bulb, passing over into an S-shaped chitinous tube, which is united by special muscles with a framework attached to the external genital plate, and can be pushed forth as a copulatory organ. The contents of the testes consist of numerous balls of seminal cells in different stages of development, besides isolated packets of filiform zoospermia arranged in whorls.

The ovary of *Chernes* has the form of a long unpaired tube beset on both sides with a number of egg-follicles; the mature ova each occupy the end of a follicle, while the peduncle is occupied by a number of small cells, and only in *Obisium* have I previously observed an epithelium surrounding the ovum on all sides. The follicles appear to persist for some time after the evacuation of the ovum; at least I sometimes found them empty, and the young ova on the cellular peduncle sprouting forth at the base. The oviducts open into a short vagina, which is surrounded by a dense accumulation of unicellular glands, and further receives two much-contorted tubular glands. These accessory glands are represented in the male by two packets of unicellular glands, the fine parallel efferent ducts of which are directed towards the genital aperture, and further on each side by two sacciform appendages lined with a flat epithelium, which are connected with the *ductus ejaculatorius* and contain a granular substance. In this way all the glandular formations situated in this part of the body would be enumerated, although, according to previous notions, the spinning-glands have their locality here. However, at any rate in *Chernes*, I could not see the smallest trace of the spinning-tubercles, stated by Menge to occur here; there were only ordinary chitinous hairs, which certainly had the arrangement described by Menge but had no connexion at all with any gland. As I repeatedly found the animals under bark during the cold season in their little watchglass-like webs, and further the spinning was actually observed by Menge, the organs implicated in it must be sought in some other part of the body, and it cannot be denied that the situation at the base of the abdomen would be anything but favourable to their function. In fact, I succeeded in disco-

vering in *Chernes* an apparatus which much better fulfils the requirements of a spinning-organ. Thus in the cephalothorax, above the brain and the anterior hepatic lobes, there are two considerable glandular masses which touch each other in the median line, and with their much attenuated anterior ends enter the basal joint of the cheliceræ. The glands themselves consist, on each side, of four or five cylindrical closely approximated tubes which contain granular cells grouped around a clear central canal; the cheliceræ receive only the narrow, chitinized efferent ducts, forming a fine bundle, which may be traced through the basal joint into the movable finger of the chela, traverses this, and enters into a soft-skinned process at its apex, which is characteristic of the genera *Chernes*, *Chelifer*, and *Cheiridium*. This process in *Chernes* terminates in four short conical points into which the ducts may be traced singly, and in which they probably open by a fine aperture, which, however, I have not been able to see distinctly. I found the same arrangement also in *Chelifer*. The structure of the chelicera itself also seems to support my interpretation, seeing that a number of processes exist upon it, and seem perfectly fitted for pulling and arranging the threads. Along the inferior surface of the movable finger there is a long comb consisting, in *C. Hahnii*, of eighteen plates; whilst on the immovable arm of the chela there is inserted a serrated and denticulated process, at the base of which rises a semicircular fold of skin.

MISCELLANEOUS.

On the Structure of the Muscular Fibres of some Annelids. By M. Jourdan.

The author has made a special study of the muscles of the integuments of the following Annelids:—*Hermione hystrix*, Kbg.: *Polynoë Grubiana*, Clap.; *Eunice torquata*, Gr.; *Syllis spongicola*, Gr.; *Phyllodoce Paneti*, Bl.; *Siphonostoma diplochætos*, Otto; *Terebella Meckelii*, D. C.; *Sabellaria alveolata*, Lam.; and *Protula intestinum*, Lam.

The form of the muscular fibres varies between rather wide limits, but they may be referred to two types—some are nearly cylindrical, others distinctly lamellar. But there is an intermediate series of more or less ribbon-like elements. The muscular fibres are sometimes fusiform and short, when they are visible throughout their whole extent in the field of the microscope; in other cases they

are much longer, their extremities are broken, and it is difficult to ascertain their length.

As constituents of these fibres may be distinguished a contractile substance remarkable for its intense coloration and its homogeneous aspect, and a nucleus accompanied by a protoplasmic substance. The existence of an enveloping membrane seems doubtful; the author thinks that in most cases there is none, and at the utmost it is only at the level of the nucleus that one can detect a delicate hyaline pellicle, which seems to keep the nucleus in contact with the element to which it belongs; but this rudimentary membrane soon disappears in contact with the muscular substance.

When these fibres are lamellar one margin is always thicker than the other, their form being like that of a sword-blade with a straight thick edge, while the thin edge is notched and furnished with irregular processes.

The contractile substance of these muscles is perfectly homogeneous, and in most cases it is impossible to discover transverse or longitudinal striæ. Some, however, present a peculiar aspect, which might seem to indicate a coarse transverse striation; colouring reagents, especially hæmatoxyline, show alternate light and dark segments, which give the fibre a banded rather than a striated appearance; and it is easy to see that these false striations represent actual thickenings of the muscular substance, and must be regarded as waves of contraction, having nothing in common with the transverse striæ of the Arthropoda and Vertebrata. In a Tubicolar Annelid (*Protula intestinum*, Lam.), which is remarkable for the dimensions and lamellar form of the longitudinal fibres of the posterior region of the body, the author has, however, found a true striation, comparable by its fineness and regularity to that of the muscles of Mammalia. This striation is manifested chiefly in the dark regions of the fibre; and while its general direction is transverse, it varies according to the point examined, so that the striæ may become more or less oblique. The striæ appear to be grouped in areas in which their direction varies more or less. They are very fine.

The author thinks that this striation in *Protula intestinum* is not unique; but he regards its occurrence here as particularly interesting, as it is in relation to the rapidity of contraction which occurs in *Protula*.

The nucleus is oval and placed outside the mass of contractile substance. The protoplasm surrounding it is sometimes very abundant and accompanies the muscular fibre through a great part of its length; but generally it is reduced to small granular masses which surround the nucleus and form irregular ridges upon the edge of the fibres.—*Comptes Rendus*, March 14, 1887, p. 795.

The Stigmata of the Scolopendridæ. By Dr. Erich Haase.

The number and structure of the stigmata is of great importance in the classification of the very uniform family of the Scolopendridæ. Thus Newport distinguished fissiform, cribriform, and so-called

"branchiform" stigmata. These "branchiform" stigmata he defined * as "spiracula circularia, membrana braniformi corrugata intus vestita," and von Porath, in establishing the genus *Otostigma* (=*Branchiotrema*, Kohlr.), also accepted this definition †. But Kohlrausch ‡ indicated that he could not find any resemblance to branchiæ in these stigmata, although he adhered to the opinion that the stigmata are *closed* from within by a branchiform membrane.

In working up the Indo-Australian Chilopoda, the results of which I shall shortly publish in a larger memoir, I was led to investigate the structure of the stigmata, which I studied particularly in tangential sections.

The simplest form is the apertural stigma, which occurs in *Lithobius* and *Henicops*, and has been fully described by me §. It is characterized by the undeveloped peritrema, by a rather short calyx, lined within with a lattice-work of setæ, and destitute of special protective apparatus, and by the cylindrical tracheæ which open simply. A similar form occurs in the young (*fœtus*, Ltz.) of the Scolopendridæ, which, after quitting the egg, lie motionless for a considerable time, and are covered by the body of the mother, in *Scolopendra* as well as in *Heterostoma*. Thus this simple form constitutes the common starting-point of the fissiform and cribriform stigmata.

In *Cryptops* the fundamental form is very distinctly marked, while in *Cormocephalus* it already leads towards the stigma of the true *Scolopendræ* by the more fissiform and margined external orifice, and by the accession of simple circlets of spines before the opening of the tracheæ. In the *Scolopendræ* the stigmatic cavity is divided into an exterior vestibule and the true calyx, and the circlet of spines before the direct opening of the tracheæ attains its highest development.

The ear-shaped (=branchiform) stigma of *Otostigma*, v. Por., and *Branchiostoma*, Newp., may be derived from the apertural stigma by regarding the calyx as obliquely compressed for a small portion of its length. On the floor of the stigma in these forms a few irregular dark-coloured islands make their appearance, and these are beset externally with the small hooklets which are so frequent in the stigmatic calices of the Chilopoda. These islands are the remains of the original floor of the stigma, while the clear straits surrounding them are formed by the gradually flattened and dilated debouching surfaces of the tracheæ. The external aperture of the ear-shaped stigmata is round and finely denticulated at the margin; there is no projecting ring as in *Scolopendra*.

* Newport, "Monograph of the.... Chilopoda," Linn. Trans. vol. xix. p. 411.

† O. von Porath, Bihang till K. Sv. Vet.-Ak. Handl. Bd. iv. no. 7 (1876), p. 19.

‡ Kohlrausch, 'Beiträge zur Kenntniss der Scolopendriden' (Marburg, 1878), p. 6.

§ E. Haase, "Das Respirationssystem der Symphylen und Chilopoden," in Zool. Beiträge, Bd. i. p. 76 (Breslau, 1884).

From this ear-shaped stigma the *cribriform* stigma (such as that of *Heterostoma*) may be derived by imagining the floor-surface of the stigmatic calyx to be considerably enlarged, the tracheæ narrowed and multiplied, and the distance between the margin of the stigma and the floor of the calyx suppressed.

Although the first pair of stigmata of *Heterostoma*, which may attain a diameter of 4 millim., even projects above the plane of the body-surface, the last stigmata exhibit a depression of the calyx &c. such as is typical of *Branchiostoma*, and thus, as the least developed, prove clearly that the ear-shaped stigma preceded the cribriform.

I have not found any transition form between the fissiform and the ear-shaped stigmata.

To the embryonic characters of the stigma in the young Scolopendridæ must be added a peculiar one, hitherto unmentioned. Each stigma is protected by a strong hook-like chitinous process of some breadth (up to 2 millim.), which is inclined over the aperture, and is to be regarded as a duplication of the pleura. This peculiar protective apparatus, which does not occur in the embryos of *Lithobius*, must, as fœtal, be contrasted with the embryonic form of the stigma, which is so significant in developmental history. It is therefore to be regarded as secondary, adapted to special conditions of life, and probably produced, like the peculiar brooding, by the tenderness and helplessness of the delicate embryos.—*Zool. Anz.* no. 246, March 14, 1887, p. 140.

On the Food of the Sardine. By MM. G. Pouchet and J. de Guerne.

The authors have examined the contents of the intestine of numerous sardines obtained from various places on the shores of the Bay of Biscay, including materials collected at the Laboratory of Concarneau. They say:—

"At Concarneau the stomachs of sardines captured on 17th June, 1882, contain only Copepoda belonging to the largest species of the European seas—*Pleuromma armata*, Boeck, and *Calanus finmarchicus*, Gunner *. These are pelagic Crustaceans, sometimes met with in considerable quantities in the open sea, but which never appear in great numbers near the shore. When they occur there in exceptional abundance they constitute what the Breton fishermen call the *boët rouge* (in Celtic, *bouéd*, food and also bait). This would exactly correspond, except, perhaps, in the identity of all the species, with the *Rödaat*, which seems to attract the summer herring (*Sommersild*) on the coasts of Norway.

"In July, August, and September, in the neighbourhood of Concarneau, our preparations show us the sardine absorbing a

* It will be noticed that all the Entomostraca here cited are indicated for the first time upon the oceanic coasts of France or Spain.

nourishment which varies according to the composition of the pelagic fauna or flora. Very different creatures occur in the stomachs with the Copepods. The latter are no longer pelagic forms; they belong for the most part to the family Harpacticidæ; *Euterpe gracilis*, Claus, must be noted among other species. Mingled with the remains of these Copepods we observe a great number of Cladocera of the genus *Podon* (*P. minutus*, G. O. Sars), which is rarely obtained by pelagic surface-fishing. Besides these Entomostraca we have recognized in several stomachs embryos and ova of small Crustaceans, setæ of young and adult Annelids, carapaces of Infusoria of the family Tintinnodea, spicules of Radiolaria, some examples of *Peridinium divergens*, Ehr., a great number of *horns* of crushed *Ceratia*, and some débris of vegetable origin.

"The sardine by no means chooses animal matters, and it may even happen that its food is exclusively composed of microscopic plants. Thus in July 1874, at Concarneau, the attention of one of us was called to the yellowish-green coloration of the contents of the intestine in the sardines, which consisted entirely of Diatomaceæ. An important fact to note is that the stomachs filled with *rogue* (cod's roe serving as bait) usually contain very little food, from which we may conclude that the sardine only *works* (*travaille*), according to the fisherman's expression, when it is fasting."

At La Corogne, where the sardine is not captured with bait, but kept alive for several days in a compact mass by means of special nets, the authors found detached scales between the branchial arches and also in the stomach, which further contained examples of *Podon minutus*, with some Copepods (*Euterpe gracilis*, Claus; *Ectinosoma atlanticum*, G. S. Brady) and embryos of Gasteropods. A microscopic Trematode (*sp. nov.* or larva ?), which is often met with at Concarneau in the open, and also attached to *Noctilucæ*, appears to be very frequent in the stomachs of sardines at La Corogne. As many as fifty were found in one fish. This is the more remarkable as the sardine is generally free from parasites.

The chief interest of the viscera from La Corogne is the extraordinary abundance of Peridinians which fill them. These belong to two types:—*Peridinium divergens*, Ehr., and *P. polyedricum*, Pouchet. The latter, hitherto known only on the shores of Provence, literally fills the digestive tube of the sardines, being recognizable even in the rectum. These Peridinians measure on the average $36\ \mu$ in diameter; bringing *P. polyedricum* to the spherical form, this gives the volume of an individual as about $25000\ \mu$. The capacity of the intestine (omitting the œsophagus, the stomach, and its cæcum) may be estimated at 1 cub. cent., so that it equals the volume of *forty millions* of Peridinians; allowing for the intestines this number may be reduced one half; but twenty millions must be regarded as a minimum, for the Peridinians break up rapidly in the intestine of the fish.—*Comptes Rendus*, March 7, 1887, p. 712.

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[FIFTH SERIES.]

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XLI.—*Parasitic Castration, and its Influence upon the External Characters of the Male Sex, in the Decapod Crustacea.* By Prof. A. GIARD*.

"WHATEVER may be said concerning the advantages to the experimenter of having no preconceived idea, it is proved by innumerable examples that one often misses those phenomena which one did not expect to meet with, and that observation is much more intense and much more fruitful when the investigator knows beforehand what he ought to find, and strives pertinaciously to find it, notwithstanding want of success at the outset" †.

In these words, when commencing his course last year, one of the masters of biology in France expressed himself, and there never has been a statement more useful to repeat. To be convinced of this we have only to run through the memoirs produced for some time past in most of our zoological laboratories. The triumph of the school of Cuvier is now-a-days complete; the intolerant dogmatism and the exclusively empirical tendencies of those who occupy the chairs of authority no longer permit any general views. Im-

* Translated by W. S. Dallas, F.L.S., from a separate copy, furnished by the author, of the paper in the 'Bulletin Scientifique du Nord,' sér. 2, année x., 1887.

† Marey, "Les Lois de la Mécanique en Biologie," 'Revue Rose,' 3rd July, 1886, p. 3.

bedding and sectioning, describing as closely as possible a microscopic preparation, detailing to the public the little misadventures of a badly-conceived histological *cuisine* are the things which constitute a presentable thesis; as to the conclusion of the memoir, that must be impressed with the greatest reserve. It will be remarked, for example, that the Brachiopoda are probably Brachiopoda, and that, in spite of all the recent works upon the Tunicata and the Bryozoa, the subkingdom Mollusca is still extant. And nevertheless the enormous mass of facts which is every day being accumulated by the naturalists of the whole world renders more and more necessary the employment of the synthetic method, without which science is a chaos. Moreover, theoretical ideas, far from being, as has been asserted, a source of error, very often enable us to correct old erroneous and imperfect views, and to render available peculiarities which, without them, would have passed unnoticed.

The present note, I think, will be a fresh demonstration of the aphorism enunciated by Prof. Marey.

I.

In the course of last summer, at Concarneau, I had the opportunity of studying a *Sacculina* parasitic upon *Stenorhynchus phalangium*, Pennant. This *Sacculina* had already been indicated, without description, by Fraisse, who met with it at Naples; I called it *Sacculina Fraissei*, in honour of that zoologist. It appears to be rather common. Although such statistics are very liable to vary and only constitute the result of a rough approximation, I estimate at about one in fifty the number of *Stenorhynchi* infested by this Rhizocephalan among those captured in the Bay of La Forest.

Sacculina Fraissei is easily distinguished from the other species of the same genus by its external form and its organization. It is entirely concealed in the sort of case formed by the tail of the crab and the sternal plastron. Its outline is cordiform. The cloacal aperture is nearly sessile, and irregularly triangular in young individuals. The chitinous ring which surrounds the peduncle is very simple and not strongly marked; the peduncle is hollow; the roots are thicker and more irregularly branched than those of *S. carcini*; the colleteric glands annexed to the ovary are well developed and situated at the sides, towards the upper third of the height. The orientation is the same as that of *S. carcini*. The ovoid, or nearly spherical, testes are situated at the median part of the posterior half of the ovaries, nearly in the centre

of figure of the parasite; each of them gives origin to a long deferent duct which reaches the posterior margin of the ovary and turns round it to open in the suprapeduncular region. *S. Fraissei* therefore belongs to the group of the *mesorchidean Sacculinæ*, the type of which is *Sacculina corculum*, Kossmann, which is parasitic upon *Atergatis floridus*. As in the case of the parasite of *Carcinus mænas*, the *Sacculina* arrives at its complete formation during the period of reproduction of the crab—that is to say, in the present case, during the months of June and July *.

Since the year 1873, when I began to study the Rhizocephala, I have found, upon the Crustacea of our shores, about twenty species of *Sacculinæ*, several of which are new to science or still only imperfectly known. Hitherto I have published nothing upon these animals. Why then have I attached particular importance to the discovery of the *Sacculina* of the *Stenorhynchus*, and devoted myself to a more active investigation of that parasite? It is because Fraisse had made an observation upon a species also parasitic upon an Oxyrhynchan, namely the *Sacculina neglecta* of *Inachus scorpio*, which, if correct, would possess great interest. Fraisse, in fact, asserted † that the males of *Inachus scorpio* are never infested by the *Sacculina*, and he attributed this immunity to the narrowness of their abdomen; he says:—"The males of *Inachus*, according to my observations, are never infested by parasites, probably on account of the different form and the smallness of their abdomen."

The sexual dimorphism of *Stenorhynchus* being just as marked as that of *Inachus*, it seemed likely that *Sacculina Fraissei* would present the same ethological peculiarity as *Sacculina neglecta*, and would infest only the females. The confirmation of Fraisse's observation would have been a fresh argument in favour of the theory of the local fixation of the embryos of the Rhizocephala in opposition to the curious hypothesis of the migration of the larvæ, recently put forward by M. Y. Delage. Seeing that in all the species of Decapods, all more or less dimorphic, in which I had met with *Sacculinæ*, I had never noticed even a comparative immunity of the male sex, Fraisse's supposed discovery seemed to me to prove *too much*. Nevertheless one could not regard it *à priori* as

* My excellent friend Prof. Marion sent me, some years ago, a *Sacculina* parasitic upon *Stenorhynchus ægyptius*, M.-Edw., which is evidently very nearly allied to *S. Fraissei*. I designate it *S. Fraissei*, var. *ægyptia*. The *Stenorhynchus* which bore it came from the muddy bottom to the east of the port of Algiers, between the gasworks and the Aga's baths.

† P. Fraisse, "Die Gattung *Cryptoniscus*, F. Müller," 1877, p. 23, note 3.

erroneous, for it seemed to have a relation to another fact of the same nature long since indicated in the case of other parasites. As long ago as 1837 Rathke wrote:—"Mirabile dictu, Bopyri omnia quæ vidi exempla—vidi autem eorum plures centurias—solummodo in Palæmonibus *feminis* repereram, licet in manus meas non pauciores horum animalium mares, quam feminæ incidissent" ('De Bopyro et Nereide,' p. 18). Choice in fixation does not seem to be theoretically more impossible in the case of the *Sacculinæ* than in that of the *Bopyri*.

However this may be, for several days I carefully examined the numerous *Stenorhynchi* which every sweep of the trawl brings up from the bottom of the Bay of La Forest. At the first glance the superficial examination that one could make on board the boat seemed fully to confirm Fraisse's opinion. On the first day of dredging I returned to the laboratory quite convinced that I brought back only female *Stenorhynchi* bearing *Sacculinæ*. This crab is so transparent that, even without lifting the tail, we can perfectly distinguish the yellowish tint of the parasite through the integuments of its host.

As in *Stenorhynchus* the number of males greatly exceeds that of the females, the apparent immunity of the former became still more singular. But a careful examination of these Crustacea soon revealed some very curious facts, although very different from that indicated by Fraisse.

In the infested females the influence of the parasite, which displays itself internally by the abortion of the ovules, betrays itself externally by a profound modification of the four pairs of ovigerous feet on the abdomen. These appendages are very inferior in size to the normal state, sometimes reduced to small scarcely plumose arcs; and we cannot ascribe their atrophy to wearing caused by the friction of the *Sacculina*. In fact, I have ascertained that in adult females upon which the recently evaginated *Sacculina* was still of very small size and removed from all contact with the ovigerous feet, the latter already presented the dwarfish and stunted aspect of aborted organs. Here therefore there is no mechanical action, but a remarkable fact of correlation of growth.

I soon observed infested *Stenorhynchi*, apparently quite similar to the preceding, in which the ovigerous feet did not exist at all; but in these cases it was easy to find, between the parasite and the sternal surface of the crab, the copulatory styles, greatly reduced in size it is true, and, further, the position of the genital apertures was different. In one word, these individuals were males in which the tail had the width

and all the external characters of the female appendage, and seemed to be arranged to protect the parasite as perfectly as it protects the eggs in the other sex.

Moreover, the secondary sexual characters of these infested males were likewise modified in the same direction as the primary characters. The chelæ of the first pair of legs, instead of being strongly developed and projecting far beyond the head as in the normal males, were feeble and reduced as in the female sex. All these peculiarities are the more striking as in its ordinary state *Stenorhynchus* is one of the Brachyurous Decapods in which the sexual dimorphism is most accentuated. A drawing of these males, castrated by the parasite, seems to be absolutely useless, as it would be confounded with the classical figures given of the female sex. The number of these males, moreover, is more restricted than that of the females (about one to six according to my statistics). In presence of this result I have every reason to think that Fraisse, being more particularly engaged in the investigation of *Cryptoniscus*, contented himself with a too rapid examination of the *Inachus scorpio* infested by *Sacculina neglecta*, and that in this Oxyrhynchan, as in *Stenorhynchus*, the male sex is not free from the attacks of the Rhizocephalan.

II.

Since 1873, I may say without exaggeration that thousands of *Carcinus mænas* bearing *Sacculinæ* have passed under my eyes. More recently M. Yves Delage, on his part, has examined a respectable number of these animals. He has done this with a very legitimate but particularly lively desire to see something that I had not seen. In other countries Kossmann has also studied the Rhizocephala with much care and success. Nevertheless neither Kossmann, nor Delage, nor myself had noticed a very important fact, which one cannot help seeing when, instead of *looking*, one *observes*. This fact may be enunciated as follows:—*When a young male* Carcinus mænas *is infested by a* Sacculina *it acquires, in part, the external sexual characters of the female sex.* The resemblance may be carried so far as to cause for a moment a difficulty in the determination of the sexes if we neglect to lift the caudal appendage.

Even last year, when I announced to the Academy of Sciences the curious observations which I had made upon the *Sacculina* of *Stenorhynchus* *, I still regarded that type as exceptional, and thought that in most of the Decapod Crusta-

* Comptes Rendus, July 5, 1886, p. 84; 'Annals,' ser. 5, vol. xviii. p. 165.

cea the atrophy of the male genital glands, caused by the presence of a *Sacculina*, was unaccompanied by any modification of the external sexual characters. Nevertheless I had a vague recollection of the embarrassing cases to which I have alluded above. Hence, on my arrival at Wimereux during the vacation, profiting by the circumstance that the *Sacculina* was comparatively abundant that summer, I examined a great number of infested specimens of *Carcinus mænas*, and I soon found it easy to recognize, and to demonstrate to my pupils, the effects of parasitic castration upon the young male crabs. So true is it that, as Marey says, " observation is much more intense and much more fruitful when the investigator knows beforehand what he ought to find, and strives pertinaciously to find it, notwithstanding want of success at the outset."

The external sexual characters of the Brachyurous Decapod Crustacea are too well known for us to delay much in describing them. It is well known that the principal one is that the tail (abdomen) of these animals is generally broad and oval in the female, while it is narrow and trapezoidal or triangular in the male sex. This abdomen is composed of seven somites, of which the first two (1 and 2) bear the copulatory styles in the male, while in the female the somites 2, 3, 4, and 5 are furnished with the plumose feet destined to support the ova. Lastly, in a certain number of species, notably in *Carcinus mænas* and in *Portunus*, the somites 3, 4, and 5 are intimately soldered together in the male in such a way that the tail appears to be formed only of five segments, thus, 1, 2, $\overbrace{3, 4, 5}$, 6, and 7.

Grobben has pointed out that the coalescence of the segments 3, 4, 5 in the male sex does not occur in certain Cyclometopa (*Eriphia spinifrons*, *Pilumnus hirtellus*), and that even in other groups of Brachyura (Notopoda, Oxystomata, Oxyrhyncha, Catometopa) side by side with forms in which there are five segments in the abdomen of the male we find others which have retained the seven primitive somites. Whence it may be concluded that the coalescence has been produced independently in the various sections of the Brachyura, and that it probably constitutes an arrangement serviceable in the act of copulation. Lastly, the chelæ are generally more developed in the male sex.

All these external sexual characters disappear more or less when the crab is rendered sterile by the presence of a parasite; the copulatory styles and the ovigerous feet are frequently more or less atrophied, but always much less so than in *Stenorhynchus*. The modification bears especially upon the general form of the tail, which in the male sex takes on the

appearance which we here reproduce (fig. III.). The whole organ, without quite attaining the width which it presents in the female sex, is nevertheless much wider than in the normal

Fig. I.

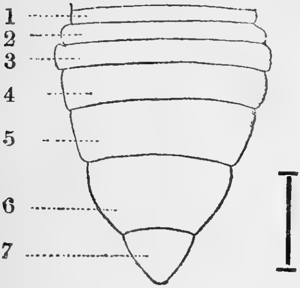


Fig. II.

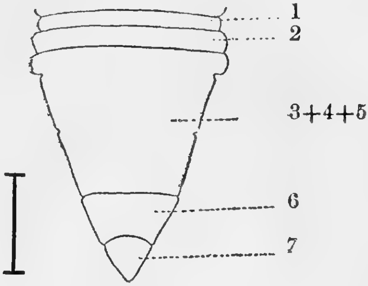


Fig. III.

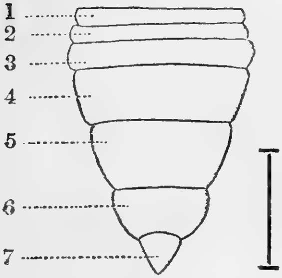


Fig. IV.

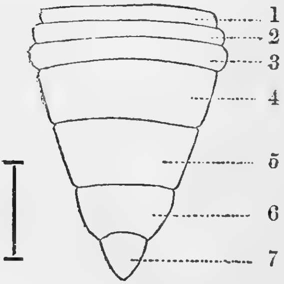


Fig. V.

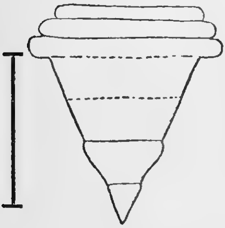


Fig. VI.

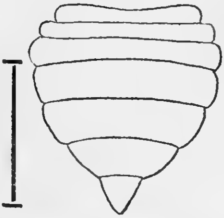
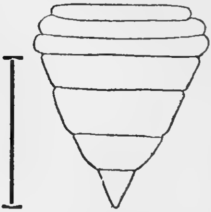


Fig. VII.



Figs. I.–III. Abdomen of *Carcinus mænas.*—I. Female. II. Male (normal). III. Male infested by *Sacculina.* IV. Male infested by *Entione.*
Figs. V.–VII. Abdomen of *Portunus holsatus.*—V. Male (normal). VI. Female. VII. Male infested by *Sacculina.*

males. The segments 3, 4, and 5 are still generally soldered together or very slightly movable, but their outlines are well marked and they seem to be quite distinct; segment 3 does

not project so much laterally beyond the following segments. Segment 6 (that which in the Macrura bears the uropods) is rounded on its free margins and presents nearly the form of a semicircle instead of being trapezoidal as in the ordinary male.

All these modifications are produced in a more or less complete fashion according as the crab has been infested at a more or less advanced age; old males bearing *Sacculinæ* do not differ at all from normal males, or, at the utmost, segment 6 is slightly dilated at its margins.

I have observed modifications exactly identical with those of *Carcinus mænas* in young males of *Portunus holsatus* infested by *Sacculina Andersonii*, sp. n. (fig. VII.).

The males of *Cancer pagurus* infested by *Sacculina triangularis*, Anderson, those of *Portunus puber*, infested by *S. Priei*, sp. n., and those of *Platyonychus latipes*, infested by *S. Betencourti*, sp. n., present much less considerable modifications.

III.

My attention having thus been attracted to the influence of parasitic castration, due to the presence of a Rhizocephalan, I examined more carefully than I had previously done the male Crustacea infested by the Isopods of the group Bopyridæ. I knew that these Isopods usually cause the sterility of their hosts. However, there are more numerous exceptions than in the case of the Rhizocephala, and in not a few instances we can still observe some activity, imperfect it is true, of the male or female genital glands of the Decapods bearing *Entoniscus* or Bopyridæ.

The young males of *Carcinus mænas* infested by *Portunion mænadis* frequently present a modification of the external sexual characters, but this modification is less profound than that which we have considered above. It consists, in the first place, of the less complete coalescence in the infested male of the abdominal segments 3, 4, and 5, and especially in the form of the sixth segment, which becomes dilated at its free margins as in the Sacculiniferous males (see fig. IV.). This latter peculiarity is very interesting. In the males bearing *Sacculinæ*, the tail being gradually raised by the parasite, it might be thought that the dilatation of the sixth somite was due to the circumstance that this segment was no longer confined within the groove hollowed out in the sternal part of the carapace of the crab. But the same explanation cannot be given in the case of the male bearing *Entoniscus*, and one is forced to assume that this modification of the sixth somite is

a phenomenon of correlation of growth without any direct mechanical cause.

I should have liked to pursue the observation of these curious facts in other species of Decapods infested by *Entione*; unfortunately these parasites are rare, and *Platyonychus latipes*, which is very frequently infested by *Portunion Kossmanni* at Wimereux, is not well adapted for the investigation of this question in consequence of the narrowness of the abdomen in both sexes.

Taking into account the facts which we have just discussed we may inquire whether the peculiarity noticed by Rathke, to which we have already referred, namely the exclusive infestation of the female prawns by *Bopyrus squillarum*, may not be explicable by a mistake analogous to that which we at first fell into with regard to the *Sacculina* of *Stenorhynchus*.

Rathke also first indicated, and all subsequent authors have confirmed this statement, that the presence of a *Bopyrus* caused the sterility of the prawn which bore it. He says:—"Haud minus memoratu dignum hoc mihi videter, quod neque eo anni tempore quo Palæmones ova sua (sub cauda) fovent, neque ullo alio tempore inter ea horum animalium exempla, quæ Bopyrum exceperant, ullum inveni cujus ova ita exculta fuissent, ut partu edi potuissent" *.

But the external characters which distinguish the sexes in *Palæmon* are not very striking. Grobben †, who has recently studied this question pretty completely in the case of *Palæmon rectirostris*, ascribes to the male the following differential peculiarities:—

1. Its size is smaller.
2. The inner branch of the first pair of abdominal feet is much more developed than in the female.
3. The second abdominal foot bears on the inside of its inner branch a styloid appendage furnished with stiff hairs ‡.
4. The branch of the first antennæ which bears the olfactory setæ is larger than in the female, and that absolutely and not only relatively to the size of the body. The olfactory setæ are also more numerous.

As the Bopyridæ generally infest the young Decapods, the first character (1) derived from the size cannot be of any use in the question now under consideration. The other characters consist in the greater development in the male of organs

* Rathke, De Bopyro et Nereide, 1837, p. 18.

† Grobben, 'Beiträge zur Kenntniss der männlicher Geschlechtsorgane der Dekapoden' (Vienna, 1878), pp. 76, 77, 79.

‡ Heller further indicates a second and smaller inner appendage, but he has mistaken for this the retinaculum ('Die Crustaceen des südlichen Europa,' Vienna, 1863).

which exist in a less degree in the female. It is reasonable to suppose that the atrophy of the genital glands must have an influence upon the development of these external organs. Lastly, as it is very probable that Rathke did not undertake a complete dissection of the infested prawns which he examined, and that he no doubt contented himself with a determination of the sexes by the most prominent external characters, there is room for an inquiry whether this determination may not have been rendered erroneous by the influence of the parasite itself, and whether Rathke did not regard as females males in which the presence of the *Bopyrus* had hindered the manifestation of the external sexual characters.

This very interesting verification might be quickly made in localities where *Bopyrus* is abundant. I may indicate as a particularly favourable spot for this investigation the little port of St. Vaast-la-Hougue. Some years ago (in 1875) I there found *Bopyrus squillarum* in great abundance. Unfortunately at that time the question under discussion had not yet arisen, and I paid no attention to the matter.

Besides the preceding cases a single example of parasitic castration is noted elsewhere among the Crustacea, namely that of a Copepod, *Cyclops tenuicornis*, infested by larvæ of *Distoma*, and in consequence presenting embryonic characters during its whole life *.

IV.

A case of parasitic castration absolutely comparable to that which we have just studied in the Decapod Crustacea has been indicated by Perez in the Hymenopterous insects of the genus *Andrena* infested by *Stylops* †. The communication of the learned professor of Bordeaux is most interesting, and does not seem to have been sufficiently appreciated by French and foreign zoologists. Hence we think it will be serviceable to reproduce here the summary of it, which was given in the 'Revue internationale des Sciences.'

Having remarked that certain species of *Andrena* constantly bear a parasite, and having closely examined these species, Perez recognized that they are only abnormal forms of other species; and this led him to study the anatomical modifications which, in the bee, are correlative with the presence of a parasite.

* Herrick, "Heterogenetic Development in *Diaptomus*," 'American Naturalist,' vol. xviii.

† Perez, "Des effets du parasitisme des Stylopes sur les Apiaires du genre *Andrena*" (Soc. des Sci. phys. et Nat. de Bordeaux, 12th June, 1879; 'Revue internationale des Sciences,' tome iv. p. 281).

In general a stylopized bee has the head smaller than a normal individual of the same species, the abdomen more globose, the integument of this latter organ sometimes discoloured, its puncturing less strongly marked, its villosity more abundant and longer upon the last segments, and presenting a marked tendency to acquire a golden-red tinge towards the extremity in those species in which the hairs of this part are fulvous or even brown. Lastly, which is even more remarkable, the female has the hind legs more slender, and their brush more or less reduced, sometimes wanting; and in the species in which the male has the face white or yellow the female acquires spots of this colour; the sting itself becomes smaller. On the other hand, the male sometimes loses the proper coloration of his face, and thus becomes more like the female. *Each sex thus loses more or less the attributes which characterize it and tends more or less to acquire those of the opposite sex.*

It must be added that a stylopized female is never seen bearing pollen on the hind legs; she plunders the flowers, but only for her own nourishment, and not to collect anything. She therefore appears to be destitute of the reproductive function, as she is deprived of certain characters which are the external signs of it.

It was natural to deduce from these facts that by its presence the *Stylops* causes the atrophy of the internal genital organs. Some authors who have paid attention to parasites have, in fact, noted in passing the atrophy of the genital organs of the host. But these data are very vague and it was necessary to check them. M. Perez ascertained that in a stylopized female *Andrena* the ovarian tubes are completely arrested in their development and the ova never attain their normal evolution; the stylopized female is unfitted for reproduction. In the male the atrophy usually affects only the testis of the side on which the parasite is situated; the sperm-cells become segmented, but without producing spermatozoids. But the testis of the opposite side attains its normal volume and is found to be distended by a great quantity of semen. The stylopized male may therefore still copulate with effect; the stylopized female probably never copulates—at any rate she cannot lay fertile eggs.

According to Perez this atrophy of the genital organs is a simple arrest of development and appears to be chiefly an effect of the pressure due to the presence of the parasite, whose body almost entirely fills the abdomen *.

* To the examples of parasitic castration above enumerated we may further add the very interesting case of the North-American squirrel,

V.

What conclusions can we draw from the observations which we have just summarized?

Keeping for the moment to the facts taken in themselves, without attempting to inquire into their primary cause, and considering them in their maximum state, that is to say, such as we observe in *Stenorhynchus phalangium*, we shall see at once that the parasite, when fixed upon a male crab, is much better protected than it would have been if the male had not undergone the modification already described. As, however, this transformation does not take place unless the crab is infested when quite young, at a time when the sexual differentiation has not yet been produced, it follows that natural selection must have determined a more and more precocious fixation of the parasite *. Hence it happens that the *Sacculinæ* of the Oxyrhyncha (1) always infest young crabs, and (2) cause a more complete atrophy of the copulatory styles and ovigerous feet.

In the Brachyura of which the sexual dimorphism is less accentuated the protection afforded to the parasite by the modified abdomen of the male is less efficacious; consequently natural selection plays a less active part, and we pretty frequently observe the infestation of old individuals. Moreover, even in case of early infestation, the modification of the male sexual characters is less considerable.

If we now seek to understand the mode in which the modifications of the external sexual characters of the Decapods are connected with parasitic castration, several explanations occur to the mind and must be examined in their turn.

1. It may be supposed that these modifications are useful to the infested crab, and, in consequence, have been gradually developed by natural selection.

It may seem strange, *à priori*, to invoke natural selection, and consequently heredity, to explain phenomena which are associated with the sterility of the animals which manifest them; but we must not forget that this sterility is only temporary, that it ceases with the existence of the parasite, and that it is not impossible that a crab which has borne a *Sac-*

Tamias Lysteri, Rich., which, according to Asa Fitch, is often castrated by an Œstrid larva, *Cuterebra emasculator*, Fitch, which resides in the testicular sac. We would suggest to our American *confrères* the complete investigation of this parasite and of the effects which it produces.

* Of course at present we have to do only with natural selection as applying to the parasite.

culina may recover and become the progenitor of a numerous family.

It may also appear paradoxical to say that it is advantageous to the crab to thoroughly protect its parasite. Nevertheless it is easy to convince one's self, by examining a crab bearing a *Sacculina*, that every excitation of the parasite produces a contraction the recoil of which is very painful to the crab. The more the *Sacculina* is sheltered the less the crab must experience pangs resulting from the contraction of the Rhizocephalan when irritated by external objects. And, further, if the *Sacculina* happens to be severely wounded, it will die and become decomposed on the spot, often causing the death of the crab, whose viscera are affected by the putrefaction of the roots of its enemy. On the other hand, if the *Sacculina* grows old, suitably protected, it has still an existence much shorter than that of its host, and when it dies its roots in time undergo a sort of dry degenerescence which does not seem at all to place the life of the crab in danger.

A priori therefore we cannot entirely reject the influence of natural selection in the transmission of the capacity on the part of the male crabs of acquiring certain modifications; but we nevertheless think that this explanation must be discarded upon considerations of comparative physiology.

It has long been known that the castration of the males of mammals and birds results in giving to the animals subjected to it the secondary sexual characters of the female sex. Perhaps it would be more correct to say that, in these cases, as in that under consideration, castration prevents the development of the male sexual characters. However this may be, in geldings and capons the sterility is complete and definitive. Now the modifications which they present are completely of the same nature as those which we have indicated among the Crustacea. We have therefore to find an explanation which may apply to all the cases.

2. We might seek this explanation in what Darwin has called "latent characters." Of these it is precisely the secondary sexual characters which furnish the best example. "In every female," says Darwin *, "all the secondary male characters, and in every male all the secondary female characters, apparently exist in a latent state, ready to be evolved under certain conditions. It is well known that a large number of female birds, such as fowls, various pheasants, partridges, peahens, ducks, &c., when old or diseased, or when operated on, partly assume the secondary male characters of their

* 'Variation of Animals and Plants,' vol. ii. p. 51.

species. In the case of the hen pheasant this has been observed to occur more frequently during certain seasons than during others [Yarrell, Phil. Trans. 1827; Dr. Hamilton, P. Z. S. 1862]. A duck ten years old has been known to assume both the perfect winter and summer plumage of the drake. Waterton [Essays, 1838] gives a curious case of a hen which had ceased laying and had assumed the plumage, voice, spurs, and warlike disposition of the cock; when opposed to an enemy she would erect her hackles and show fight. Thus every character, even to the instinct and manner of fighting, must have lain dormant in this hen as long as her ovaria continued to act *. The females of two kinds of deer, when old, have been known to acquire horns."

Lastly, every one knows that in many women after the cessation of menstruation the chin and upper lip become clothed with a regular beard, a phenomenon the relation of which to the development of the male plumage in old hen pheasants cannot be denied.

"On the other hand," says Darwin (*l. c.*), "with male animals, it is notorious that the secondary sexual characters are more or less completely lost when they are subjected to castration. Thus, if the operation be performed on a young cock, he never, as Yarrell states, crows again; the comb, wattles, and spurs do not grow to their full size, and the hackles assume an intermediate appearance between true hackles and the feathers of the hen. Cases are recorded of confinement alone causing analogous results. But characters properly belonging to the female are likewise acquired; the capon takes to sitting on eggs, and will bring up chickens; and, what is more curious, the utterly sterile male hybrids from the pheasant and the fowl act in the same manner, 'their delight being to watch when the hens leave their nests and to take on themselves the office of a sitter.' That admirable observer Réaumur asserts that a cock, by being long confined in solitude and darkness, can be taught to take charge of young chickens; he then utters a peculiar cry, and retains during his whole life this newly acquired maternal instinct. The many well-ascertained cases of various male mammals giving milk show that their rudimentary mammary glands retain this capacity in a latent condition."

We have cited textually these passages from Darwin, of which the conclusion is that "*in many, probably in all, cases, the secondary characters of each sex lie dormant or latent in*

* "Isid. Geoffroy St.-Hilaire in his 'Essais de Zool. Gén.' (1842), has collected such cases in ten different kinds of birds. It appears that Aristotle was well aware of the change in mental disposition in old hens."

the opposite sex, ready to be evolved under peculiar circumstances."

Examples of a similar abnormal development of the characters of one sex in the opposite sex are not unknown among the Crustacea. Grobben * has several times met with females of *Astacus fluviatilis* in which the first pair of abdominal feet were constructed as in the male. The ovaries were well developed, and these females bore ova upon the other feet. Grobben interprets the fact as a simple transfer of the characters of one sex to the other, which, he adds, is not uncommon in the animal kingdom.

E. von Martens has noted the presence of female genital apertures in the male of *Astacus plebeius* †. Hilgendorf has likewise ascertained the presence of rudimentary female genital orifices upon the third pairs of feet of the males of certain Crustacea ‡.

We may remark that in the case of the crabs infested by *Sacculinæ* there is not in reality, as we have already pointed out, any manifestation of female characters in the male sex, but rather an absence of the development of the male characters; the animal remains in a young stage, not sexually differentiated, but acquiring a somewhat larger size. This is also, in our opinion, what occurs in castrated mammals and birds. While the females whose ovaries have been destroyed or no longer function acquire the positive characters of the male sex (horns, spurs, hackles, &c.), the castrated males are modified especially in this direction, that they do not acquire the attributes of their sex. It is true that it may be remarked that in the cases cited by Darwin, as in that of the Sacculiniferous Crustacea, it is the female that most closely approaches the stock-form and presents the fewest secondary sexual characters. Nevertheless one does not see why the female Brachyura furnished with *Sacculinæ* do not lose their ovigerous feet which have become useless.

3. The fact that in cases of infestation there is really no manifestation of female characters in the male sex, or of male characters in the female sex, leads us to attribute the modifications of which we have been speaking to a simple arrest of development of the external characters of the two sexes, an arrest of development which is more noticeable in the male, because in that sex the secondary sexual characters are, in the normal state, much more developed than in the female.

* 'Beiträge zur Kenntniss der männlicher Geschlechtsorgane,' p. 83.

† Senckenb. Ges. naturf. Freunde, 1870, p. 1.

‡ Die von Herrn W. Peters in "Mozambique gesammelten Crustaceen," Monatsb. Akad. Berl. 1878, pp. 782-851. See also Tagbl. der Versamml. Deutscher Naturf., Cassel, 1878.

In support of this view we may cite here some very correct ideas put forward by Isid. Geoffroy Saint-Hilaire in his 'Zoologie générale' with regard to female birds in male plumage. He says:—

"We may assume theoretically the existence in most species of birds not of a brilliant plumage proper to the male and of a dull plumage proper to the female, but, in general, of two plumages, one *imperfect*, belonging especially to the young, the other *perfect*, which the males acquire very early and which the females also tend to acquire, but at a much more advanced age and under certain peculiar circumstances" *.

And further on he adds:—"It has been said that the young of both sexes have the plumage of the female; but is this statement perfectly correct? Is it really the case that the male in his youth has the permanent plumage of the female? Or, which is theoretically very different, is it not that the female retains more or less completely the plumage of youth, which, as regards her colours, is arrested in development and does not arrive at the conditions characteristic of the perfect state of the species?" (*l. c.* p. 492).

Further, "The old female in the course of those remarkable phenomena which tend to render her more and more like the male, seems to tend to pass through all the same phases which the male pheasant traverses in his youth. A female, when her laying is about to cease or has just ceased, and a young male are in conditions which may be compared in many respects. Both have the same plumage, the imperfect plumage; both will have again, at a more or less distant period, the same plumage, the perfect plumage of the species. The same change must therefore take place in both cases, since the starting-point is the same, and the old female and the young male tend towards the same end. But the changes take place with very unequal rapidity in the one and in the other; one requires several years, a single year suffices for the other. Moreover the order in which the change is effected is not exactly the same. It will be sufficient to compare the young males preserved in all our museums, with the details that I have given of the old females, to see that in the two cases the change takes place in a different manner. It is never possible to say of an old hen pheasant in which the change has commenced that she has exactly the plumage of a young cock pheasant of such or such an age. It is therefore by two different ways that nature advances in the one case and the other towards similar final results" (*l. c.* pp. 507, 508).

* 'Essai de Zoologie générale,' 1841, p. 492.

VI.

Generally we think that the modifications due to parasitic castration must be assimilated to those which are the result of *progenesis*. We say that there is *progenesis* when in an animal sexual reproduction occurs in a more or less precocious manner, that is to say, when the sexual products (ova or spermatozoids) are formed and matured before the creature has attained its full development. As examples may be cited the axolotls and larvæ of Tritons, which, the former normally, the latter occasionally, oviposit while they still possess their branchiæ.

Very often progenesis affects only one sex. Sometimes it is the female sex that ripens in the larval state, as in the Aphides *, *Stylops*, &c. Sometimes it is the male sex, as in *Bonellia*, the complementary males of the Cirripedes, the pigmy males of the Rotifera, the male of the salmon and the eel, &c.

In other cases again the animal presents the two sexes successively with progenesis in one of them. Thus there is *protandric progenesis* in the Cymothoadian Crustacea, which are males when young, and become females as they grow old and complete their development. The case of old female Gallinaceæ with masculine plumage and instincts, on the contrary, seems to be an imperfect example of *protogynic progenesis*, since these females have laid eggs when they had still the livery of the young, and have subsequently continued their development and presented the characters of the males, without, however, the production of spermatozoids having been seen.

In extreme cases of female progenesis reproduction even takes place without the assistance of the male element, thus reverting to the primordial agamic form. These cases have been long known under the name of *pædogenesis*. They have been observed in the larvæ of *Miastor* and *Chironomus*, and in certain Aphides. The supposed alternation of generations in the Trematoda must also be regarded as a very strongly marked case of female progenesis (pædogenesis), and so also perhaps in other cases still regarded as examples of alternation of generations.

Whenever there is progenesis in a particular type we therefore recognize either momentarily or definitely an arrest of

* According to a very recent note by M. R. Moniez there is in certain Aphides [Coccidæ] *progenesis* in the male. In this case (*Lecanium hesperidum*) the male remains rudimentary and in a manner parasitic on the female, like the male of *Bonellia* ('Comptes Rendus,' February 14, 1887).

growth and development; the progenetic animal has consequently the aspect of a sexual larva when compared either with the other sex or with allied forms which do not present the phenomenon of progenesis.

This is in perfect harmony with the principle so well elucidated by Herbert Spencer of the *antagonism between genesis and growth and between genesis and development*. This antagonism is easily explained if we consider that the materials employed in reproduction cannot serve for the growth of the individual. If it is advantageous to an animal to reproduce without acquiring useless organs, natural selection will soon determine a more and more complete progenesis. Parasitic animals besides that they draw from their host an abundance of nourishment, have no need of a number of organs which serve their free congeners in their relative life. Thus we see that a very great number of parasitic animals are progenetic. The progenetic males of *Bonellia* and the Cirripedes live as parasites in their females. In certain types (Aphides) progenesis ceases when, the food becoming less abundant, a change of locality may be necessary.

In short the arrest of development due to progenesis results from a deflection of the nutritive principles to the detriment of the progenetic animal. In the examples of parasitic castration that we have studied the parasite acts, with regard to its host, absolutely the same part as the genital gland of a progenetic type. It diverts, for its own support, a portion of the principles which should have served for the development of the infested animal. The effects produced are also exactly of the same kind.

It is curious to observe to what an extent, in certain cases, the parasite seems to take the place of the absent genital products. The *Entonisci* occupy precisely the position of the sexual glands of the Decapod Crustacea, and so nearly assume their aspect that we have thought we had before us an hermaphrodite of *Carcinus mœnas*, when we had to do with a male bearing a mature *Portunion mœnadis*.

The *Sacculinæ* and *Peltogasters* are developed in the very place which the extruded eggs of the crabs and hermit-crabs normally occupy. It is the same with *Phryxus paguri* and *hippolytes*. I am even much inclined to believe that, by a very singular reflex action, these parasites produce upon their host the same effect that would be produced by oviposition. The Decapods seem, in fact, to defend their parasites against attacks from without. A crab never frees itself from its *Sacculina*, even when it has every facility for so doing, and it is only when one places together several Crustaceans bearing

Rhizocephala that any misfortune happens to the latter. But the same thing takes place if we place together several females loaded with eggs; each one defends her own, but does not hesitate to devour those of her neighbours.

It cannot be objected to this view that the males are infested as well as the females, for these infested males are emasculated and acquire the instincts of the female, like the capons or the unfertile hybrid pheasants, which sit on the eggs and bring up the young *.

VII.

Besides the intrinsic interest they possess the observations that we have just brought forward have considerable importance from various points of view.

1. In the first place it is probable that ignorance of the modifications produced by the parasite in the external sexual characters of its host has frequently given rise to errors analogous to those of Fraisse, and consequently this diminishes to a certain extent the value of the older statistics with regard to the Rhizocephala, a value which was already not too great from many other considerations.

* We have indicated elsewhere that *maternal love* has its origin in a simple reflex action which is agreeable to the parent and occurs sometimes in the form of paternal love (fishes), sometimes in that of maternal love properly so called (birds and Mammalia). It is remarkable to find that this explanation was foreseen by Mauduyt as early as 1783. Thus in the 'Encyclopédie' (Oiseaux i. art. Coq, p. 61), with regard to the attachment of the hen for her eggs and chickens, we read as follows:—

"Is this attachment rational, or is it the sensual product of the contact of the egg? What might lead us to admit the second supposition is that this attachment on the part of the hen does not relate to her own eggs only, but she sits with the same assiduity and perseverance that she shows towards her own eggs upon all those which are given to her, of whatever kind they may be, and even upon inorganic bodies which have no resemblance to eggs but in their form. It is not the colour that deceives her, for I have given a hen to sit the eggs of a Cayenne bird of a very dark greenish-blue colour, and she did not quit them until I took them away."

Mauduyt also perceived that the female psychical characters of castrated males were directly acquired and not the result of the development of a latent instinct. Thus we read (*l. c.* art. Coq, p. 618) with regard to capons employed in brooding:—"To succeed in this enterprise the belly of the capon to be employed is plucked and rubbed with nettles; he is then shut up in a room with two or three chickens; these young animals, approaching the capon in search of the warmth which they found under their mother, make him experience a coolness which is agreeable, because it moderates the burning sensation that he feels; he lends himself in consequence to their wishes, and in a little time the business of brooding becomes so agreeable to him that he will hardly allow the chickens to escape from under his wings."

2. As the infested young male crabs are the only ones which become modified in the female direction, it becomes easy to determine the relative proportion of those which have been infested when adult, which could not hitherto be done at all rigorously *. Our statistics, which unfortunately are only founded upon a restricted number of individuals, prove nevertheless that M. Delage was wrong in supposing that infestation in the adult state was quite exceptional. It is, on the contrary, comparatively frequent in *Carcinus mænas.*

3. As the modification of the external sexual characters is the result of the profound lesion of the genital glands, we must conclude therefrom that the latter already exist at the time of the infestation, or at least that they are in course of formation, which indicates approximately the epoch of the fixation of the parasite.

VIII.

The fact that a parasite provokes in its host an abnormal development of organs which protect it at the expense of its victim seems at the first glance very exceptional. Nevertheless we must not see in it any teleological argument, but simply a mutual adaptation which is not without analogy with numerous facts of symbiosis (whether between animals of two different species or between animals and plants), facts which form a series of which the case now under consideration may be regarded as an extreme term.

The deformations produced in various plants by the *Cecidomyiæ* or the Cynipidæ are absolutely phenomena of the same kind.

An equally curious case is that of the white campion (*Melandryum album*) infested by *Ustilago antherarum.* It is well known that the white campion is normally a diœcious plant. The young flower is hermaphrodite. But upon certain plants the ovaries are aborted; on others the stamens remain rudimentary. When the parasitic fungus is developed upon a male plant it fructifies in the stamens; but when it falls upon a female plant it would seem at first that it could not fructify, and this would be so much to the profit of the infested plant. This, however, is not so, for in this case the plant completely develops its rudimentary stamens to enable the parasite to fructify, just as the male *Stenorhynchus* widens its abdomen to protect the *Sacculina Fraissei.* Selection acting at once upon the host and upon the parasite has set up a

* The size of the infested individuals does not furnish a sufficient indication from this point of view, as sexual maturity may be produced in individuals of very different sizes.

modus vivendi between these two creatures; the name of symbiosis has been very justly given to this *modus vivendi* in those cases in which the two organisms draw a reciprocal profit from their association, and it seems to me desirable even to extend it to the extreme cases that we have been investigating.

XLII.—*On new Batrachians from Malacca.* By G. A. Boulenger.

[Plate X.]

Mr. D. F. A. Hervey has presented to the Natural History Museum a collection of Reptiles and Batrachians obtained within a radius of fifty miles from the town of Malacca, which was exhibited in the Straits Settlements Court at the Colonial and Indian Exhibition. The lizards, of which two species were new, have been mentioned in the Appendix to the British Museum Catalogue of Lizards. Of the Batrachians two species are new to the Malay peninsula, viz. *Rana laticeps*, Blgr., and *Microhyla achatina*, Boie, and four are new to science and described below.

Rana labialis. (Pl. X. fig. 1.)

Allied to *R. chalconota*. Vomerine teeth in two oblique series between the posterior borders of the choanæ. Head considerably longer than broad, much depressed; snout long, acuminate, projecting beyond the lip; nostril twice as distant from the eye as from the end of the snout; loreal region deeply concave; the diameter of the eye equals its distance from the nostril; interorbital space a little broader than the upper eyelid; tympanum very distinct, usually about three fourths the diameter of the eye, sometimes quite as large as the eye. Fingers rather slender, first not extending as far as second; toes moderate, three-fourths webbed; tips of fingers dilated into large disks, the diameter of which equals about half that of the tympanum; tips of toes dilated into small disks; subarticular tubercles moderately developed; two small metatarsal tubercles, outer rather indistinct. Hind limb slender; the tibio-tarsal articulation reaches the tip of the snout or a little beyond. Upper surfaces finely granulate; a glandular lateral fold, distinct only anteriorly; lower surfaces smooth. Brown or purple above, darker on the sides, with rather indistinct darker spots; tympanum chestnut-brown; a

white band on the upper lip; limbs with more or less distinct dark cross-bands; hinder side of thighs and lower surface of hind limbs with brown reticulation; throat and breast spotted or marbled with brown. Male with internal vocal sacs; without humeral glands.

From snout to vent: male 35 millim., female 50.

Several specimens.

PHRYNELLA, g. n. (Engystomatidarum.)

Pupil horizontal. Tongue elliptical, entire, free behind. Vomerine teeth none. No ridges across the palate. Tympanum hidden. Fingers free, toes extensively webbed; tips of fingers and toes dilated. Outer metatarsals united. No præcoracoids; sternum cartilaginous. Diapophyses of sacral vertebra moderately dilated. Terminal phalanges T-shaped.

Phrynella pulchra. (Pl. X. fig. 2.)

Physiognomy of a *Callula*. Head small, with short, truncate, projecting snout; eye moderate, its diameter a little less than the length of the snout; interorbital space nearly twice as broad as the upper eyelid. Fingers depressed, dilated into large subtriangular disks; first finger shorter than second; subarticular tubercles very large and flat. Toes nearly entirely webbed, feebly dilated at the end; a small, oval, flat, inner metatarsal tubercle. The tibio-tarsal articulation hardly reaches the posterior border of the eye. Skin smooth, or with small flat warts on the sides and hinder part of the back. Brown above with symmetrical darker spots, some of which are edged with a pink line; throat and lower surface of foot brown; belly, groin, and lower hinder side of thighs yellowish (in spirit); vent in a large dark brown spot, separated from the dark colour of the back and thighs by a zone of the yellowish colour of the lower surface. Male with an internal subgular vocal sac.

From snout to vent 39 millim.

Two specimens, male and female.

Bufo parvus. (Pl. X. fig. 3.)

Near *B. biporcatus*, with which it agrees in the disposition of the cranial ridges. Snout very short, truncate, projecting considerably beyond the mouth, the nostrils anterior to the vertical of the lower jaw; the interorbital space as broad as, or a little broader than, the upper eyelid; tympanum very distinct, vertically oval, close to the eye and two thirds to

three fourths the diameter of the latter. First finger extending considerably beyond second; toes hardly half-webbed, with simple subarticular tubercles; two rather strong metatarsal tubercles; no tarsal fold. The tarso-metatarsal articulation reaches between the eye and the end of the snout, the end of the snout, or even a little beyond. Upper surfaces rough with very prominent, conical, often spiny tubercles; parotoids prominent, round or subtriangular, scarcely larger than the tympanum; lower surfaces with round tubercles of unequal size. Brown above, with a few darker spots, and often with a few scattered irregular spots of a beautiful pink; limbs with dark cross-bands; lower surfaces spotted with brown; throat brown in the males, which are provided with a subgular vocal sac and black asperities on the inner side of the two inner fingers.

Numerous specimens, caught during the breeding-season. The largest male measures 41 millim. from snout to vent, the unique female 50.

Bufo quadriporcatus. (Pl. X. fig. 4.)

Intermediate between *B. biporcatus* and *B. galeatus.* A straight, prominent, supraorbital ridge, continued into a short parietal; a strong and broad orbito-tympanic ridge continuous with the parotoid, which is prominent and compressed, ridge-like. Snout short, truncate, projecting far beyond the mouth; canthus rostralis well-marked, loreal region nearly vertical; interorbital space much broader than the upper eyelid; tympanum very distinct, vertically oval, close to and nearly as large as the eye. First finger extending considerably beyond second; toes short, hardly half-webbed; two moderate metatarsal tubercles; no tarsal fold. The tarso-metatarsal articulation reaches the eye. Crown smooth, back with small warts. Parotoids much elongate; the distance between their posterior extremity and the orbit equals the distance between the end of the snout and the extremity of the parietal crests. Pale brown above, whitish inferiorly; a narrow dark line along the canthus rostralis and the parotoid; limbs with dark cross-bands.

A single specimen, apparently half-grown.

Whilst describing the preceding *Bufones,* I have reexamined a specimen of an allied species from Puerta Princesa, Philippine Islands, collected by Mr. Everett, which has been for some time in the Museum, but which I had put aside as a probably new species without being able to make up my mind to describe it. I now think the specimen may safely be made the type of a new species, to be named

Bufo philippinicus. (Pl. X. fig 5.)

Cranial ridges rather similar to those of *B. biporcatus* (*cf.* Boul. Cat. Batr. Ecaud. p. 311, fig.); but the supraorbital ridge ending in a very short branch, directed inwards and distinct from the parietal, which is more thickened. Snout short, truncate; canthus rostralis prominent; interorbital space broader than the upper eyelid; tympanum very distinct, vertically oval, smaller than the eye—the vertical diameter of the right side is $4\frac{1}{2}$ millim., of the left side 4 millim., and the horizontal diameter of the eye $6\frac{1}{2}$ millim. First finger extending much beyond second; toes half-webbed, with simple subarticular tubercles; no tarsal fold. The tarso-metatarsal articulation reaches the eye. Upper parts with small, conical, spiny tubercles; parotoids oval, as long as their distance from the anterior border of the orbit. Olive above, with darker insuliform spots; cranial ridges reddish brown.

The unique female specimen measures 75 millim. from snout to vent.

XLIII.—*On new Siluroid Fishes from the Andes of Columbia.* By G. A. Boulenger.

A small collection of Fishes made by Mr. F. A. Simons in Columbia (locality not mentioned), and purchased a few years ago by the Trustees of the British Museum, consists of five species, viz.:—*Trichomycterus dispar*, Tsch. (*maculatus*, C. & V.), *T. tænia*, Kner, and the three novelties of which descriptions follow.

Stygogenes Guentheri.

D. 1/6. A. 6. P. 1/9–10. V. 1/4.

Head as broad as long, two sevenths of the total length (without caudal). Eyes very small, about one fourth the width of the interorbital space, midway between the anterior nostril and the posterior border of the head. Barbel not quite half the length of the head. Dentition and labial folds as in *S. Humboldtii.* A small rough spine to the adipose fin; sometimes another at the base of the caudal. Outer ray of each paired fin thickened, flexible, slightly prolonged, covered with small spines directed backwards; outer pectoral ray

longer than ventral, extending to the middle of the latter. Origin of the dorsal fin just behind the ventrals. Male with a long anal tube, and the posterior anal rays agglomerated and stiff. Pale olive-brown above, spotted or marbled with blackish brown.

Eight specimens, the largest measuring 83 millim.

Chœtostomus setosus.

D. 1/7–8. A. 1/3. P. 1/6. V. 1/5. L. lat. 25.

Head large, much depressed, as long as broad, its length being one third of the total (without caudal); occipital and nuchal regions flat. Eye small, its diameter one third the width of the interorbital space. Margin of the snout granulated, with short and fine bristles in the female and long and strong ones in the male; interopercular spines numerous and strong, setiform, curved at their extremity, the hindermost the largest and measuring half the length of the snout. Scutes spiny, the spines being arranged in lines, not keeled; no distinct posthumeral ridge. Thorax and belly naked. Dorsal fin a little longer than high; the anterior rays measure two thirds the length of the head; the length of its base is less than its distance from the caudal; four or five scutes between the two dorsal fins. Caudal fin not forked, lower rays longest. The pectoral spine extends to beyond the base of the ventral, which extends to the anal. Eleven or twelve scutes between anal and caudal. Olive above, indistinctly spotted with darker; fins yellowish, with round black spots; lower parts uniform yellowish.

Total length 120 millim.

Two specimens, male and female.

Trichomycterus nigromaculatus.

D. 8. A. 6. P. 9. V. 5.

Head as broad as long, six and a half times in the total length. The depth of the body contained eight and a half times in the total length. Eye very small, one fourth the length of the snout, one third the width of the interorbital space. The nasal barbel extends to the occiput, the upper maxillary to the base of the pectoral. Opercular and interopercular prickles strong. Upper ray of the pectoral prolonged into a short filament. Origin of the dorsal fin in the middle of the total length. Anal fin entirely behind the

dorsal, which is considerably behind the base of the ventrals. Caudal not forked. Pale brown above, with numerous black spots of unequal size.

Total length 135 millim.

Two specimens.

XLIV.—*On the Reproductive Elements of the Spongida.* By H. J. Carter, F.R.S. &c.

It is not necessary now to question whether the Spongida are propagated by male and female elements of generation, that is by spermatozoa and ova in the usual way, as so many have described and illustrated these elements in different species of the class, beginning as far back at least as 1826, when Grant described and delineated the ova in *Spongia panicea* and *S. papillaris*, now *Halichondria incrustans* and *H. panicea*, Bk. (Edinburgh New Phil. Journ. vol. ii. p. 127 &c. pl. ii. fig. 26 &c.), and 1856, when Lieberkühn described and illustrated the spermatozoa in *Spongilla* (Archiv f. Anat. u. Physiol. Heft i. p. 17, and Heft v. p. 500, Taf. xviii. figs. 9 and 10). But still it remains to be pointed out from what parts of the sponge these elements are respectively derived.

Following the discoveries as they were made, let us first direct our attention to the ovum.

By "ovum" I wish to be understood to mean that stage in which this element is chiefly characterized by the *presence* of the germinal vesicle; the segmentary stage, that in which it is chiefly characterized by the *absence* of the germinal vesicle; and the embryonic state, that in which it is chiefly characterized by the addition of cilia or motory organs to the surface.

At the earliest period in which I could detect the ovum (in *Halichondria lobularis*) it was about 1-3000th in. in diameter, which was thus but a little larger than the spongozoon ("Geissel-" or "Kragenzell" of the Germans); while later on, that is when about 1000th in. in diameter, it presented all the characters of an unimpregnated sponge-ovum—that is, presenting the germinal vesicle and germinal spot surrounded by a polymorphic or amœboid envelope, in which state it then appeared to me *in* the substance of the sponge ('Annals,' 1874, vol. xiv. pp. 329 and 350, pl. xx. fig. 3, *a–c*).

Now, as the monociliated spongozoon of the ampullaceous sac (a certain time after having been separated from its con-

nexions) retracts its cilium and bodily falls down into the form of a creeping amœboid cell, the latter may be a spongozoon which, migrating in this form through the plastic substance of the sponge, carries about with it the ovum, and thus becomes one of the so-termed "amœboid" or wandering cells of the sponge. Hence the origin of the ovum in one of these may be conjecturally explained. But this is not always the case, as will presently be seen, from which and additional instances of a similar kind we shall learn that, in form, location, and composition, the germinal elements of the sponge may vary more or less with the species to which they belong.

After the ovum has gone through the segmentary stage it passes from its location in the substance of the sponge into the neighbouring excretory canal, where Grant, in 1826, described and represented it in *Halichondria panicea*, Bk., in the following words:—"By examining the sponge carefully with the microscope we are surprised to find that many of the mature ova are now hanging by their tapering extremity from the parietes of the internal canals" (*op. et loc. cit.* p. 129, pl. ii. fig. 26); all of which was verified in *Tethea zetlandica*, Cart., in 1872 ('Annals,' vol. ix. p. 426, pl. xxii. figs. 14 and 15).

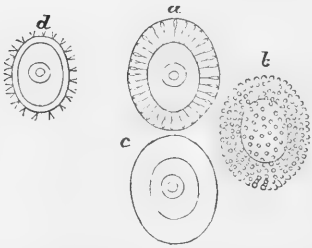
After this the ovum, now in its embryonic state, gets out into the water through one of the vents on the surface of the parent sponge.

In the Calcisponges the ovum is first seen in the substance which fills the interval between the chambers or ampullaceous sacs, that is, *outside* the latter; passing afterwards, as it assumes the embryonal form, into the chamber itself, and thence through the inner aperture of the chamber into the cavity of the cloaca, whence it finally issues through the orifice of this cavity, also into the water.

Returning to the ovum in the Carnosa or fleshy sponges, I fortunately have found among Mr. Wilson's Australian specimens an ovigerous one of *Chondrosia spurca*, viz. that to which I have alluded in the 'Annals' of 1886 (vol. xviii. p. 274), and again in the present year (vol. xix. p. 288), in which the ova, of which there is a *single* one of considerable size in several of the ampullaceous sacs respectively, are not too small to escape being recognized, nor too large to have destroyed all trace of these sacs by having extended beyond their limits (see woodcut, p. 352); thus the sac, which is elliptical in form, averages 14-6000ths in. by 11-6000ths in. in its greatest diameters, and the ovum, which is also elliptical, 8-6000ths by 6-6000ths in. in its greatest diameters; so that the latter is a little more than half the size of the former. Each ovum consists of a capsule closely applied to the sac of the granular yolk on one

side and on the other, or outside, in continuation with the beaks of the spongozoa (woodcut, *d*) ; while the germinal vesicle which is spherical, averages 2-6000ths in. in diameter, and the germinal spot, which is circular and opaque, about 1-6000th in. ; so that the interval between the ovum and outer border of the ampullaceous sac is filled up by the spongozoa (*a*).

Now, when the ovigerous portion of the sponge is torn to pieces for microscopic examination many of the ova become detached or separated, and then they are seen to be fringed circumferentially with the filamentous remains of the beaks of the spongozoa, which, radiating from them all round, kept the ovum in position within the ampullaceous sac (*d*).



a, ovum as seen under deep focussing, in which the spongozoa surrounding it are only visible ; *b*, ovum under less deep focussing, in which the whole of the spongozoa covering the ovum come into view ; *c*, ovum in the cell of the ampullaceous sac without any spongozoa ; *d*, ovum out of the ampullaceous sac, showing the capsule with shreds of beaks of spongozoa attached to it.

There is no difficulty whatever in seeing all this clearly in a well-preserved specimen when the sections are thin and mounted in glycerine, especially when stained.

Every ampullaceous sac on the inner portion of the sponge (where the ova are, as usual, chiefly developed) contains a *single* ovum about the size mentioned, and on *no* occasion have I observed more than one, nor have I been able to distinguish anything like a spermatoid development. I state this because hereafter I shall have to notice another specimen of the same species in which there appears to be a spermatoid development without any ova.

It must therefore be inferred that in this instance the ovum is developed *within* the ampullaceous sac, that it originated there, and that finally it would, in the embryonal state, find its way through the opening of the ampullaceous sac (which by that time, from the enlargement of the ovum, will probably have become totally effaced) into the excretory canal. Thus

it is evident that at this stage, viz. when the ampullaceous sac and the ovum are seen together, the exact position of the latter can be easily determined.

If, then, it be assumed that each spongozoon is the animal representative *par excellence* of the sponge (that is, that it contains both alimentary and reproductive organs), then it may be assumed that it possesses an ovary, and that the ovum originally comes from this source. It does not follow that all the ovicells of an ovary should be fertile or finally produce a new being if any, or that the whole of the spongozoa of the ampullaceous sac should, as in the present instance, be *not* called into requisition to produce a single ovum ; for Nature is by no means particular in these matters so long as she can effect her object in a single instance, that is, the reproduction even of a single being.

With reference to the season during which the sponges in this country produce and ripen their ova, I can only state from *actual* observation that, in the Calcareous Sponge called "*Grantia compressa*," this takes place between the months of March and June inclusively. In March the ova begin to appear, in April they are very evident, in May all three stages, viz. ova, segmentary, and embryonal, may be present, in June the embryonal form is abundant, and by the end of July they have left the parent in an effete and apparently exhausted state, after which I do not know what becomes of it.

Thus, so far as *Grantia compressa* goes for *this* locality, I think the student may safely depend on these data, while during all this time a plentiful supply of the species may be obtained from little pools in the rocks, which often exist almost as high up as "high-water mark;" therefore at any time between high and low water they are easily accessible.

I cannot say so much for the calcareous sponges in this locality, as it was not my purpose to follow the development of the ovum in them in the same way; but from having found so many siliceous sponges in an ovigerous condition about the month of August, I should say that this would be the best time to look for them also, although hundreds of specimens may be examined before meeting with one sponge that is ovigerous.

Then, for the student who wishes to follow the reproductive process throughout, hoping perhaps that he may thus also see the spermatozoa, it is not only necessary to find a specimen in an ovigerous condition, but to know when the ova begin to appear and when they have passed into the embryonal state ready for exit in the species which may have been selected for observation.

Dr. Grant's observations were made at Leith, in the Firth of Forth, during the months of October of one to that of March of the following year (*op. et loc. cit.*), and I have found ovigerous specimens of *Isodictya simulans* and *Halichondria sanguinea here* in the month of January. So that it is impossible to say in the present state of our knowledge whether the reproductive process in the marine sponges is confined to any particular season or period, or is going on throughout the year.

Most of the sponges which were sent to me by Mr. Wilson from "Port Phillip Heads," on the south coast of Australia, were in an advanced ovigerous condition, in which the germinal vesicle was, for the most part, still visible, and these were dredged in the month of January, which corresponds to our summer.

Now, from the marked characters of the ovum, its large size, and the long time it remains visible in the sponge before its exit, it is much easier to be seen than the almost infinitely smaller spermatozoon, which never grows beyond a certain size and then quickly disappears.

I have already stated that Lieberkühn discovered the spermatozoa of the sponge in 1856, which was just thirty years after Grant had discovered the ova in *Halichondria panicea* &c., since which many have described and delineated them in different sponges, to wit:—Häckel in *Calcispongiæ*, in 1871 (1)*; Eimer in a species of *Reniera*, in 1872 (2); F. E. Schulze in *Halisarca lobularis*, in 1877 (3); Metschnikoff in *Halisarca Dujardini*, in 1879 (4); Keller in his *Chalinula fertilis*, also in 1879 (5); and Poléjaeff in *Sycandra raphanus*, in 1882 (6). While Lieberkühn, Schulze, Metschnikoff, and Poléjaeff respectively have delineated the spermatozoa (in abundance) within the "spermatoa" †, and separately out of them, so that in these instances we have representations of them in both conditions.

But although both Schulze and Poléjaeff have kindly furnished me with admirable preparations of them while

* (1) Jenaische Zeitschrift f. Med. &c., Bd. vi. p. 644.
(2) Archiv f. mikroskop. Anat. Bd. viii. Heft 2, p. 281.
(3) Zeitschrift f. wiss. Zoologie, Bd. xxviii. p. 24, and Taf. iii. figs. 17 and 18.
(4) *Ib.* Bd. xxxii. p. 352, Taf. xx. figs. 2, A, B, C.
(5) *Ib.* Bd. xxxiii. p. 330, Taf. xviii. figs. 5 and 6.
(6) Sitzungsb. d. k. Akad. d. Wiss., math.-naturw. Classe, Bd. lxxxvi. Abth. 1, 1882, p. 276 &c. Taf. i. & ii., Nov. Heft.

† *Spermatoa*: "The nucleated cell in which the spermatozoa are developed" (*Owen*). *Ap.* Pascoe, 'Zoological Classification,' p. 293, Glossary, 2nd ed.

within the "*spermatoa*" (the former in *Halisarca lobularis* in 1877, and the latter in *Sycandra raphanus* in 1883), I cannot, in my spirit-preserved specimens of ovigerous sponges (some of which were taken off the rocks at this place), where they *appear* to be present, be satisfied that they are so; nor do I think, without seeing them in their *living state in motion*, it would be possible almost under any circumstances in their *separate* state, that is out of the "spermatoa," to find them; for even when two or three only are left within the spermatoon, a microscopic power, according to Poléjaeff, of from 800 to 1500 diameters is required for this purpose.

In both Schulze's and Poléjaeff's preparations, which consist of microscopic slices stained and mounted on glass slides, the spermatozoa are evident where all together in the "spermatoa;" but the "spermatoa" not only vary in size in different species, but also in the same specimen, while the form of the head of the spermatozoon also differs—circumstances to which I have already alluded, in order that the student should not expect everything to be exactly alike in every instance.

Thus in *Halisarca lobularis* the "spermatoa" on Prof. Schulze's slide vary under 15-6000ths inch in diameter, while on Dr. Poléjaeff's (viz. in *Sycandra raphanus*) they do not exceed 5-6000ths.

Again, the head of the spermatozoon in *Spongilla*, as represented by Lieberkühn, is oval, acuminated backwards or towards the tail. That of *Sycortis quadrangulata* (*Grantia ciliata*, Bk.), according to Häckel, is elliptical, acuminated at each end ('Die Kalkschwämme,' Atlas, Taf. xlviii. fig. 7). Those which I saw in July 1870 in *Microciona atrosanguinea*, Bk., under a power of from 3 to 600 diameters (described in the 'Annals,' vol. vi. p. 339, but not figured until 1874, vol. xiv. pl. x. figs. 17–20), were flask-shaped, with the acuminated end anteriorly, very like those represented by Eimer in 1872; while two of those delineated by Schulze in *Halisarca lobularis* have hammer-shaped heads—that is, the head is ovoid, but applied to the tail transversely; and in Poléjaeff's delineations from *Sycandra raphanus* they are spherical.

How far the shape of the head of the spermatozoon may be polymorphic, and therefore vary in form according to circumstances, even in the same species or specimen, I am unable to say, so would not lay much stress on these differences; while, whatever the shape may be, each appears to be furnished with a single light-refracting globule or nucleus.

As the spermatozoa are developed in a nucleated cell, viz. the "spermatoon," they may sometimes be in a preliminary

stage or small form, when they could not be distinguished from common granules, and then the "spermatoa" might be confounded with the early stage of the ovum itself; while in the Calcisponges they might be thus confounded with the large cells of the embryo or larva, when these have become separated from that body; or, indeed, with the nucleated granuliferous cells in the advanced segmentary stage of the ovum generally, that is the yolk-cells, when the latter have become extravasated by the bursting of the ovum.

Again, the only means of distinguishing the "spermatoon" in the sponges where it approaches in size that of the ampullaceous sacs is by the relative smallness of the spermatic granules in the former and their want of definite arrangement, which makes them look as if they were heaped together indiscriminately; hence probably the German term "Spermaklumpen." In this size and state also the "spermatoon" may be easily confounded with the enlarged ovum, whose glistening spherical yolk-granules at this period very much resemble those of spermatozoa, especially if the germinal vesicle be hidden or has just disappeared.

Lastly, in the living state their presence in a matured condition is so transient that, connected with the chance of their being present at all with this transitory condition, many specimens might have to be examined before they are met with, that is between the time of their being eliminated in a matured state and their passage into the ovum; while the crucial test after all, viz. that of seeing them applied to the ovum itself, has only been witnessed and represented by one person, viz. Prof. Häckel (*op. cit.* Atlas, Taf. xlviii. fig. 6, *Sycortis quadrangulata* = *Grantia ciliata*, Bk.).

I have above stated that, in the ovigerous specimen of *Chondrosia spurca* (which must now be regarded as my "*Halisarca reticulata*" in the "Supplement" to Mr. Wilson's sponges, 'Annals,' 1886, vol. xviii. p. 274), I could find nothing but ova, that is, no spermatoid development; but the opposite is the case in another specimen, where there appear to be a great number of "spermatoa" and *no* ova. These cells are spherical and about 2-6000ths inch in diameter, thus distinctly contrasting in size with the spongozoa of the neighbouring ampullaceous sacs from the smallness of the latter, while there is nothing else present of this kind with which they could be confounded. In some instances they are distinctly nucleated and in others as distinctly filled with sharply-defined, small, opaque, spherical granules, all of which are about the same size. If this development is spermatic, then the specimen must be viewed as producing the male elements

only of the species; but whether this is accidental or indicative of a *diœcious* nature I cannot say; and, after all, it may be nothing but the "glary bodies" of *Chondrosia* tinged with the dye (Hyde's violet ink) of the preparation.

It would not be right to leave this subject without referring to the additional elements of reproduction in the freshwater sponges which have been called "gemmules."

I need not enter now into the structure of these so-called "seed-like bodies," nor the development of the sponge from them, as this has been done elsewhere, but would, *en passant*, observe that while Lieberkühn was chiefly engaged with the *ovular* development of *Spongilla* from the River Spree in 1856 at Berlin, I was almost exclusively engaged with that of the gemmule at Bombay, simply because I never, to my knowledge, saw an ovum in any stage in any Bombay *Spongilla*, although I often sought for it, being desirous of seeing the swarm-spore or embryo so satisfactorily described and delineated by Lieberkühn.

As regards the origin of the gemmule, no more is known than of that of the ovum in the marine sponges. All that I can state of it from actual observation in the living sponge was published long ago, viz. in 1849, and nothing of this kind, I believe, has been done since. It is as follows:—"At the earliest period of development in which I have recognized the seed-like body it has been composed of a number of cells united together in a globular or ovoid mass (according to the species) by an intercellular substance similar to that just described ['mucilaginous']. In this state, apparently without any capsule and about half the size of the fully-developed seed-like body, it seems to lie free in a cavity formed by a condensation of the common structure of the sponge immediately surrounding it. The cells of which it is now composed appear to differ only from those of the fully-developed sponge-cell in being smaller, in the colourless state of their germs, and in the absence of hyaline vesicles; in all other respects they closely resemble the sponge-cells, possessing also a like but more limited power of motion" ('Annals,' 1849, vol. iv. p. 87). These cells and those composing the "condensation of the common structure of the sponge" were not illustrated till 1856 (*ib.* vol. xviii. pl. vi. figs. 41 and 42), when all that is stated of them that is of consequence here is in the "Explanation of the Plates" (*ib.* p. 245), viz. as follows:—

"Fig. 41. Ovibearing sponge-cell, still polymorphic, from the seed-like body at an early period, viz. before the capsule is formed. Spherical form 1-700th inch in diameter."

By "ovibearing" here is meant the "germs" which this cell contains. I had never seen a genuine *sponge ovum* at that time.

"Fig. 42. Form of a sponge-cell which exists in a layer around the young uncapsuled seed-like body."

By a reference to the illustrations it will be seen that the two cells, so far as their contents go, are remarkably different. And it is worthy of remark that a similar cell to that of "no. 42" (charged with granules and a small nucleus), also in plurality, forms a capsular layer around each ovum in some if not all the marine sponges—at all events in *Darwinella* and *Dendrilla rosea*.

Now these observations, which were carefully made at a time when I was much more able to pursue such investigations than I am at present, I believe to be correct, and therefore quite as good now as ever they were. But they do not lead us a bit further back to the *origin* of the seed-like body than the earliest state in which the ovum has been recognized leads us back to *its* origin. And even if we could trace back the seed-like body to a single cell no larger than the ovum at this period, the resemblances probably would be so great that it would be impossible to say whether it would develop into a gemmule or into an embryo.

Up to this time we neither know what relation the first cell of the seed-like body bears to the genuine ovum, nor whence either ovum, spermatozoon, or gemmule respectively are *originally* derived.

If the spongozoon be identical with the free, solitary, flagellated infusorium *Codosiga*, as first supposed by James-Clark (Mem. Boston Soc. Nat. Hist. 1867, vol. i. pt. 3, pp. 19 and 20, pl. ix. figs. 40–44, pl. x. fig. 64), then, by assuming that *Codosiga* possesses the organs which produce the elements of sexual reproduction, the like may be conceived of the spongozoon, in which case these elements in the Spongida might originate in the same way. But all this remains to be proved, and without proof assumptions are but vague aspirations.

As regards the comparative size of the matured ovum (that is, the embryo) and the gemmule respectively, I find that this varies almost always with the species, as well as in the same specimen. Thus the largest embryo that I have seen in the marine sponges is that of *Stelospongus flabelliformis*, Cart., one of Mr. Wilson's ovigerous specimens from "Port Phillip Heads," on the south coast of Australia, where it is spherical and *one sixth* of an inch in diameter; whilst the largest gemmule that I have seen is that of the freshwater

sponge *Parmula* (*Spongilla*) *Brownii*, Bk., from the river Amazon, which averages 1-28th inch. Hence the former in size looks like a small pea and the latter like a pin's head. But the *size generally* of the matured ovum in the marine sponges much exceeds that of the gemmule in the freshwater sponges, while both are equally abundant when present in their respective species; although it is seldom that an ovigerous specimen is found among the former, while I hardly ever found one of the latter without gemmules.

Generally, too, the ova are largest in their matured forms in the Psammonemata or so-called "Horny Sponges," and when one of the size mentioned, after having been preserved in spirit for some time, is cut in two, its contents present themselves in the form of a firm, transparent, jelly-like substance charged with granuliferous cells. These cells, which are spherical, may be of two sizes, viz. one, the largest, 20-6000ths inch in diameter, and the other, or small one, from 2 to 3-6000ths. The former consists of a very delicate, transparent, spherical membrane (?effete), filled with the latter, which in their turn are nucleated, more or less opaque, and filled with light-refracting granules. The capsule of the ovum in this condition and size is colourless, translucent, and very tough; and in the sponge which I have described under the name of *Geelongia vasiformis* it was found in many instances to be budding out from the circumference in three or more places into short processes which, viewed under the microscope, presented all the characters of amber-coloured, horny, laminar, genuine fibre; but on account of this development having taken place in the body of the parent, I considered it "abnormal," and therefore have described it under this heading ('Annals,' 1885, vol. xv. p. 308).

I find also a similar development of large and small cells (?mother and daughter) in an advanced state of the ovum in *Halichondria sanguinea*, and therefore it is probably only the result of yolk-cell division in all.

But, again, it is worthy of remark that it is closely analogous to the contents of the seed-like body or gemmule ('Annals,' 1849, vol. iv. pl. iii. fig. 6, *a*, *b*, *h*), wherein the large, transparent, membranous, delicate spherical cells are filled with small, compressed, transparent ones of different sizes mixed with a great number of free granules, instead of small, spherical, nucleated cells, rendered more or less opaque by their granular contents, as in the advanced state of yolk-cell division in the ovum. Indeed the similarity is so great and the subsequent development of sponge-structure, both from the embryo and the gemmule, so much alike, that one is inclined

to regard the two as identical. What relation, then, does the ovum bear to the gemmule?

Finding a long time ago, viz. in 1859, that the seed-like body of *Spongilla* and the so-called "winter egg" of the Bryozoa were so much alike ('Annals,' vol. iii. p. 331, pl. viii.), I have been induced latterly to use the term "statoblast" for the seed-like body or gemmule, but have not introduced it here, as the latter terms are most generally understood.

I have also omitted to allude to the peculiarities in the ovigerous reproduction of *Suberites domuncula* (and there may be many others which have not come under my notice), in which the ova are deposited about the summit of a small conical shell apparently enclosed by the sponge for this purpose, in the form of yellow, corneous, spherical capsules possessing a distinct and beautiful structure, preferring rather to direct the reader's attention to my illustrated description of this ('Annals,' vol. xii. 1883, p. 30) than to confuse him with unnecessary detail, as I have already stated at the commencement generally that neither the form, nor the location, nor the composition of the elements of reproduction in the Spongida are exactly the same in all species.

P.S.—Having had to consult Keller's excellent memoir "On the Organization and Development of the Chalinida" while writing the above, I find that what I have stated of the position and form of the ampullaceous sac &c. in the 'Annals' for March last (p. 209) is amply confirmed by Keller's delineation of the structure of his *Chalinula fertilis* (Zeitschrift f. wiss. Zoologie, Bd. xxxiii. Taf. xviii. fig. 1).

XLV.—*Descriptions of new Species of* Papilionidæ, Pieridæ, *and* Lycænidæ. By W. F. Kirby, F.E.S.

In the present paper I give descriptions of one *Papilio* from New Guinea, two Pieridæ from South America, and sixteen Lycænidæ from Africa. The tailless African Lycænidæ are but little known; and I have ventured to propose two new genera for some of the species here described. Figures of most of the species described in the present paper will probably appear at a later period. The types are all contained in the collection of Mr. Henley Grose Smith.

Papilio bicolor.

Exp. al. circa $4\frac{1}{2}$ in.

Black; eyes partly surrounded with white; incisions white: fore wings with a white band at three fourths of their length, extending from the costa to two fifths of the width of the wing, and composed of a series of linear or subbifid stripes: hind wings tailed, with a broad white band of a slightly creamy or greenish shade, commencing on the outer half of the costa, which it nearly covers in the male, though narrower at this point in the female; it is then indented within in the male, and curved outwards towards the cell in the female; basally it covers the extremity of the cell, and then curves towards the anal angle, before reaching which it ceases; on the outer side this pale band is greatly indented, especially on its upper portion. On the under surface of the fore wings the series of subapical stripes extending from the costa are larger and more numerous, but, except the basal part of the upper ones, consist only of grey dusting: the pale band on the hind wings is reduced to five white spots running from the costa, corresponding to the outer part of the band; the first and last are simply lunules, and the three middle ones are deeply indented on the outside, and are followed by blue dusting; towards the anal angle are two yellow spots, that nearest the base rounded, and that beyond the white spot in the anal incision linear; in the female there is also a submarginal row of linear yellow spots on the under surface of the hind wings.

Hab. New Guinea.

Daptonura limbata.

♀. Exp. al. 2 in.

White; fore wings dusted with ashy at the base and along the costal third, beyond which the costa, which is narrowly black from the base, becomes more distinctly so; the hind margin is moderately broadly brown, most broadly on the costa; opposite the middle of the hind margin is a long shallow excavation into the white, and the brown border is again slightly continued along the inner margin at the anal angle: hind wings with a narrower ashy border, not indented externally and hardly extending either to the tip or anal angle. Underside white, immaculate: hind wings a little yellowish. Club of the antennæ tipped with yellow.

Hab. Ecuador.

Allied to *Pieris iloire*, Godart.

Pieris subflavescens.

♀. Exp. al. $2\frac{1}{4}$ in.

White, dusted with bluish grey at the base and on the basal part of the cell of the fore wings; the costa of fore wings narrowly and the hind margin broadly blackish, and twice broadly indented with white: hind wings white, with a black border slightly extending along the nervures, and ceasing before the anal angle; fringe white. Fore wings beneath as above, but the costa narrowly yellow, and the inner and lower part of the black border only present, the tip being obliquely yellowish, divided by the black nervures, and shading into whitish internally: hind wings buff-yellow, with narrow black veins (except the discocellular nervule), and slightly marked with orange at the base.

Hab. New Granada.

Allied to *P. tovaria*, Feld., and hardly distinguishable on the upperside.

Liptena parva.

Exp. al. $1\frac{1}{4}$ in.

Wings brown along the margins and the costa of fore wings, red at the base for half their length on the fore wings below the cell in the male, and partly including the cell in the female (in which there is a notch in the middle of the front edge of the red colouring), and for two thirds of their length on the hind wings. Under surface of female yellow: fore wings red in the same place as above; two black stripes on the costa running down to the cell, and marked outside with white before the end of the cell, where stands a large black spot, bordered with white before and behind, followed by an irregular series of about five black white-bordered spots running towards the anal angle; hind margins of both wings with a row of black spots marked within with white dashes; on the basal half of the hind wings are several large black spots, partly bordered with white, and (except those close to the base) arranged in two irregular rows. In the male the ground-colour is less defined and the spots are larger and more irregular, the spot at the end of the cell of the fore wings and the band beyond being suffused into one large irregular blotch.

Hab. Cameroons.

The smallest described species, not nearly allied to any other.

Larinopoda varipes.

Expands $1\frac{1}{2}$ in.

White: fore wings, with the costa, tip, and hind margin blackish brown; costal border with a rounded projection just above the cell, and shortly afterwards passing into the marginal border, which occupies the apical third of the wing, but rapidly narrows, becoming very narrow and ceasing at the anal angle; its inner edge is a little irregular, especially towards the costa and anal angle: hind wings with a narrow, ill-defined, blackish hind-marginal border, commencing below the tip. Underside: fore wings with a black basal streak on the costa, projecting downwards above the extremity of the cell, where it ceases; apical and hind-marginal border ashy grey rather than black, and narrower than above, hardly reaching the anal angle: hind wings with a narrow ashy-grey border, longer and better defined than above, and with three conspicuous round black spots—one near the end of the cell, one between this and the inner margin below the origin of the lower branch of the submedian nervure, and a third near the tip between the first two branches of the median nervure. Legs reddish, the tips of the tibiæ, and the greater part of the tarsi, black.

Hab. Ashanti.

Tingra maculata.

Exp. al. $1\frac{1}{4}$–$1\frac{1}{2}$ in.

White, tinged with tawny yellow at the base: fore wings with the tip ashy, marked with three white spots on the costal margin and three on the hind margin, and followed by three ashy spots (nearly confluent with the dark tip in the male) before the anal angle; four dark spots in the cell, the second transverse, the fourth at the end of the cell, rather widely separated from the others; above the cell are two or three more spots, alternating with those in it, and below the cell is a large spot near its extremity and sometimes a smaller one nearer the base: hind wings with seven submarginal spots—a spot at the end of the cell, and sometimes another obliquely below it, and a third above the middle of the cell. Under surface similar, with a double row of submarginal spots on the fore wings, and in the male on the hind wings also.

Hab. Cameroons.

Differs from *T. abraxas* in the double submarginal row of spots on the underside of the fore wings.

The insect figured by Hewitson (Ex. Butt. iii., *Pentila* and *Liptena*, f. 1) as a variety of the female of *Pentila* (*Tingra*)

tropicalis, Boisd., is another allied species, and may be called *T. Hewitsonii.*

Tingra torrida.

Exp. al. $1\frac{3}{8}$ in.

White, tinged with orange towards the base: fore wings with the tip ashy, and two brown spots below it on the hind margin; a brown spot at the end of the cell on all the wings: hind wings with six marginal brown spots. Underside similar; fore wings with a second spot at half the length of the cell, the apex not ashy, but the hind margin with six spots, preceded at the end of the costa by three linear ones.

Hab. Gaboon.

Closely allied to *T. abraxas*, Doubl.

Pentila evanescens.

Expands 1 inch 3 lines.

Yellowish white, shading into tawny yellow towards the hind margins: the costa of the fore wings narrowly edged with black, rather more broadly for the last fourth of its length before the tip; the upper half of the hind margin of the fore wings and the hind margin of the hind wings from the middle to the anal angle very narrowly edged with black. Underside uniform dull yellowish white, the hind margins a little yellower and the fringes tawny yellow, edged within with a dull brown line; an obscure tawny spot at the end of the cell on the fore wings.

Hab. Cameroons.

A very obscure species, somewhat resembling a small pale *Cœnonympha* in appearance.

Genus Teriomima.

Upper median nervure five-branched, third branch emitted beyond the end of the cell; palpi rather long, ascending.

Type *T. subpunctata.*

The species I have placed together under this heading agree in neuration, but differ somewhat in the length and texture of the wings. In the type they are almost entire, while in *T. erastus*, Hew., &c. they are visibly scalloped; but the gap is partially bridged over by other species.

Allied to *Liptena* &c.

Teriomima subpunctata.

Expands 1 inch 1 line.

White, costa blackish at the immediate base; tip blackish

for one third of the costal length, and for the upper two thirds of the length of the hind margin; two brown spots (one at the anal angle) below. Under surface thickly spotted with brown: fore wings with one spot in the cell and two at the extremity: a row along the costa, and two submarginal rows from the costa, the outermost consisting of six small spots, but not extending to the anal angle, and the innermost slightly oblique and consisting of four larger spots: hind wings with two submarginal rows of spots, most of which are linear, and many spots nearer the base, which might be regarded as forming two or three irregular rows, the most conspicuous being two in the cell, and a large irregular one marked with white in the centre, which stands second from the costa.

Hab. West Africa (?).

Teriomima puella.

Expands 1 inch 1 line.

Tawny yellow: fore wings with a black costal streak at the base, three costal spots beyond, and the tip black for the apical fourth, then rather irregularly narrowing along the hind margin, and disappearing before the anal angle. Underside of fore wings tawny yellow, with four spots on the costa towards the base, followed by a black stripe running downwards and outwards but ceasing at one third of the width of the wing; beyond this is another costal spot, and an interrupted black line on the upper half of the hind margin. Hind wings paler tawny, the fringes with indistinct linear spots, the centre with eight spots, the centre one at the end of the cell, and the remainder forming nearly a circle round it, two on the costa, one in the cell near the base, and the other four curving round near the inner margin and the lower part of the hind margin.

Hab. West Africa.

Teriomima tenera.

Expands 1 inch 1 line.

Wings yellow: fore wings with the costa narrowly but very distinctly irrorated with black and yellow; the tip from two thirds of the length of the costa broadly black, the colour sloping outwards and then curving round the hind margin moderately broadly, but ceasing just before reaching the anal angle, which is marked with a black dot: hind wings with seven marginal spots at the extremity of the nervules. Underside: fore wings, costa irrorated with black at the base, then with four small black spots on the nervules between

the middle and a larger black spot at the tip, followed by small elongated black spots on the hind margin, on the nervules, which are nearly connected; a conspicuous black spot at the end of the cell: hind wings with no spot in the cell, but with a black spot at the tip, followed by five marginal spots at the extremities of the nervules, larger, more separated, and better defined than on the fore wings. Antennæ black, very narrowly ringed with white.

Hab. Gaboon.

Teriomima similis.

Expands 1 inch.

Yellow, fore wings with the tip and hind margin rather broadly black: hind wings with the hind margin from below the subcostal nervure with a moderately broad black border. Underside rather paler, the costa and hind margin irrorated with black, forming indistinct spots at the extremities of the nervures, most conspicuous towards the tip of the fore wings and on the hind wings; there are more conspicuous black dots at the end of all the cells, and the costal area, the cell of the fore wings, and the greater part of the hind wings are marked with scattered black scales. Antennæ black, annulated with white.

Hab. Ashanti.

Teriomima erasmus.

Exp. al. $1\frac{1}{2}$ inch.

♂. Yellow, more intense towards the base: fore wings with the costa black, and irrorated with blackish at the base and over the basal and upper part of the cell; the tip and hind margin black, the latter strongly bidentate: hind wings with a broad black marginal band, slightly angulated, but not indented within. Undersurface pale yellow, flushed with orange towards the costa to the end of the cell on the hind wings, and considerably beyond it on the fore wings: fore wings with the costa sparingly irrorated with black, a large black spot at the tip and anal angle, and three other spots on the hind margin between: hind wings with six black spots on the hind margin, that at the tip larger, and that at the anal angle smaller than the others.

Hab. Angelo.

Allied to *Pieris erastus*, Hew.

Teriomima flaveola.

Very similar to *T. erastus*, Hew., but the male of a deeper yellow, especially at the base; the band of the fore wings is

much less deeply indented with the ground-colour, and the spots of the hind wings are either separate or all connected in the male; and in the female, which is paler, the band is entirely connected, except that the spot at the anal angle is a little irregular. Under surface as in *T. erastus*, but the orange extends over most of the cell in the male, and the black marginal markings of the upperside are visible in sulphur-yellow in the male.

Hab. Ashanti and Cameroons.

Teriomima dispar.

Exp. al. 1¼ inch.

♂. Dark brown, fringes grey, underside paler brown, with three obsolete reddish-grey stripes in the cell, some obsolete pale dots towards the costa, and a still more indistinct double row of submarginal dots: hind wings with a red submacular band across the middle, two rows of less distinct reddish spots nearer the base, and a double row of very indistinct submarginal markings.

♀. Brown: fore wings with a tawny stripe commencing just beyond the cell and widening towards the hind margin, which it does not quite reach. Under surface nearly as in the male, but with the markings much better defined, and the band of the fore wings reproduced, but paler.

Hab. Cameroons (♂) and Ashanti (♀).

The insects here described as sexes may prove to be distinct when more specimens are received. They have some resemblance to *Lucia emperamus*, Snell.

Teriomima (?) *Hildegarda.*

Exp. al. 1 inch.

Tawny: hind margins and tip of fore wings rather broadly brown, between which and the cell are four brown transverse stripes on the costa; they are partly connected, and below the third is a black spot at the end of the short cell. Underside of fore wings reddish (paler on the inner margin), with four anastomosing leaden-brown bands running from the costa near the base, not extending much below the cell; towards the tips are two oblique anastomosing bands, branching to the fringes, which are also brown: hind wings brown, with about six rows of nearly connected red spots.

Hab. Ashanti.

Allied to *Liptena aslanga* (sic), Trimen.

Genus Citrinophila.

Allied to *Teriomima*. Upper median nervure six-branched;

first branch emitted at the end of the cell, the second some distance beyond, dividing into three very short branches at the extremity, the lowest reaching the tip.

Type *C. marginalis.*

Citrinophila marginalis.

Exp. al. 11 lines.

Lemon-yellow; the costa and hind margins broadly black; at the base of fore wings the black covers even the cell, but leaves its lower and outer half free; at the extremity of the cell the black descends along the discocellular, forming a small tooth; inner margin of hind wings irrorated with black. Underside paler yellow: fore wings with the costa indistinctly spotted with brown on the nervules, a small black dot at the upper angle of the cell, and the hind margin narrowly black: hind wings with a black dot on the subcostal nervure just before the end of the cell, and a smaller one between this and the inner margin below the cell; the rest of the wing is indistinctly irrorated with scattered black scales; hind margin with small black irregular spots on the nervules, becoming continuous beyond the middle, but again interrupted before the last spot at the anal angle. Antennæ ringed with white.

Hab. Ashanti.

Citrinophila limbata.

Closely allied to *C. marginalis*, but rather larger and the wings rather more rounded; the upperside is of a more orange-yellow, with the borders broader, blacker, and a little more irregular. Under surface paler than above: fore wings with the costa narrowly and irregularly black, a large square spot at the end of the cell, and the tip marked with a square black spot continuous with a slightly irregular and submacular marginal band sparingly dusted with yellow and continued narrowly to the anal angle: hind wings with a similar band, commencing with an irregular blotch at the tip and narrowly continued to just within the anal angle. Abdomen yellow (black above in *C. marginalis*).

Hab. Cameroons.

Lucia (?) *brunnea.*

Exp. al. 1 inch.

♀ (?). Brown, an obsolete pale curved stripe running across both wings at two thirds of their length, and expanding on the inner margin into a large yellow spot. Underside much paler, the band yellowish grey, narrow and curved on the

fore wings, nearly straight and uniformly broad on the hind wings; there is also a submarginal row of obsolete blackish spots indistinctly bordered with yellowish grey on both sides on all the wings beneath.

Hab. West Africa (?).

XLVI.—*Description of two new Species of* Danainæ. By H. Grose Smith.

Mangalisa timorica.

Female.—Upperside. Brown. Anterior wings with a submarginal row of small spots, two subcostal spots, beneath which are two elongated spots, the upper one less than half the length of the lower, below which between the discoidal nervules is a small lunular spot; beneath the first, second, and third median nervules are three elongated quadrate spots divided by the nervules: all the spots pale yellow and transparent. Posterior wings with a submarginal row of spots, the space between the costa and the cell as far as the first subcostal nervule, a small spot below the latter, the cell and two spots beyond it, and the basal two thirds of the space beneath the cell intersected by the brown nervules pale transparent yellow.

Underside. Same as above but paler.

Exp. $2\frac{3}{8}$ inches.

Habitat. Timor (*Forbes*). In the collection of H. Grose Smith.

In shape resembles *tytia*, but the wings are narrower, and it is much smaller than any of this group.

Amauris bulbifera.

Differs on the anterior wings from *damocles* and *hecate* in having a large bulb-shaped spot with a neck elongated to the central band, situated between the second discoidal nervule and the first median nervule; the central band is larger, and both wings are broader and rounder than in either of the abovenamed species. The posterior wings in the male brown, somewhat lighter towards the base; in the female the basal portion is white.

On the underside is a submarginal regular row of seven white spots, the uppermost beneath the first subcostal nervule, and the lowest beneath the first median nervule.

Exp. $3\frac{3}{8}$ inches.

Habitat. Cameroons; in the collection of H. Grose Smith. Two specimens only, male and female.

XLVII.—*Descriptions of some new Genera and Species of Curculionidæ, mostly Asiatic.*—Part III. By Francis P. Pascoe, F.L.S. &c.

[Plate XI.]

Brachyderinæ.

Astycus scintillans.

Otiorhynchinæ.

Epizorus, n. g.
—— Simpsoni.

Hylobiinæ.

Dinichus, n. g.
—— terreus.

Amalactinæ.

Exarcus, n. g.
—— Hearseyi.

Camptorhininæ.

Camptorhinus turbatus.

Calandrinæ.

Otidognathus comptus.
—— celatus.
Ommatolampus stigma.
Sphenocorynus meleagris.
—— rufescens.
—— conformis.
—— ocellatus.
Cercidocerus heros.
Eugnoristus tristis.
Nassophasis pictipes.
Neoxides, n. g.
—— bilineatus.
Laogenia laticollis.
Tyndides luctuosus.

Sipalinæ.

Rhina Meldolæ.

Astycus scintillans.

A. oblongus, niger, nitidus; rostro trisulcato; prothorace ad latera elytrisque squamis aureo-viridibus inter granulos numerosos adspersis. Long. 7 lin.

Hab. Sumatra.

Oblong, black, shining, the prothorax and elytra closely covered with minute granules, between them—except on the disk of the former—small brilliant golden-green scales; rostrum with a narrow median groove and a shorter one at the side; antennæ ferruginous, clothed with scattered silvery hairs; prothorax about as long as broad, rounded at the sides; scutellum oblong, spreading out at the base; elytra gradually rounded to the apex, striate-punctate, the punctures indistinct; body beneath covered with minute grey scales and hairs, and much punctured; legs blackish brown, with scattered hairs and setæ; inner edge of the fore tibiæ denticulate.

A very distinct species, with not quite the facies of its congeners. An allied species from Rangoon has ovate elytra, more decidedly punctured and conspicuously longer tibiæ and tarsi.

Epizorus.

Characteres fere ut in *Elytruro*, sed scrobes apice profundæ, versus oculum gradatim desinentes et elytra postice haud producta.

The exponent of this genus is a large and striking insect clothed above with small bright golden-green scales in the intervals of numerous minute dull black granules, which, to a certain extent, neutralizes their brilliancy. As in *Elytrurus*, there is a well-marked scutellum. The only specimen I have seen was kindly presented to me by Mr. Simpson, of the Royal Geographical Society.

Epizorus Simpsoni.

E. ovatus, modice convexus, niger, squamulis minutis aureo-viridibus granulisque numerosis indutus; scutello parvo, transverso. Long. 12 lin. (rostr. incl.).

Hab. Salomon Islands.

Ovate, moderately convex, black, above with numerous black granules, the intervals clothed with minute golden-green scales; rostrum stout, flattish, continuous with the head, in front a narrow raised median line, terminating in a triangular smooth glossy space; antennæ terminal; scape extending to the prothorax; the two basal joints of the funicle longest; club narrowly lanceolate; prothorax slightly transverse, rounded at the sides, truncate at the base and apex; scutellum short, transverse; elytra broader than the prothorax at the base, strongly rounded at the sides, faintly striate; body beneath with pale scattered hairs and scales; first abdominal segment as long as the three next together, separated from the second by a slightly curved line; legs roughly setose; tibiæ nearly straight; claws small, approximate.

Dinichus.

Rostrum subtenue; *scrobes* lineares, laterales. *Antennæ* mediocres; *funiculis* articulis duabus basalibus elongatis, cæteris moniliformibus; *clava* breviter ovata. *Oculi* parvi, rotundati. *Prothorax* subangustus, lobis ocularibus nullis. *Scutellum* nullum. *Elytra* basi prothorace haud latiora. *Femora* mutica, in medio crassiora; *tibiæ* apice inermes, posticæ corbellis apertis; *tarsi* breves, articulo penultimo subbilobo; *unguiculi* liberi. *Abdomen* segmentis duobus basalibus ampliatis. *Metasternum* haud elongatum.

An anomalous genus which I have placed in my collection after the Hylobiinæ, but from which it differs in its small round eyes, lateral scrobes, unarmed tibiæ, and short linear

tarsi. In facies it has a slight resemblance to certain Amycterinæ—*Ædriodes* for example.

Dinichus terreus. (Pl. XI. fig. 7.)

D. oblongo-ovatus, squamositate fusca tectus; prothorace elytrisque tuberculatis, hoc apice bifido; tibiis rugosis. Long. 5 lin.

Hab. Tasmania.

Oblong ovate, closely covered by a dark brown squamosity; rostrum moderately slender, coarsely punctured; scrobes beginning at a third part from the apex, straight along the side, and ending at the lower margin of the eye; antennæ ferruginous, slender; scape clavate; two basal joints of the funicle equal in length, the rest moniliform; prothorax longer than broad, a tubercle on each side anteriorly and two on the disk; elytra about three times as long as the prothorax, each with three or four lines of small narrow tubercles and two larger ones posteriorly; body beneath minutely granulate; legs clothed with coarse greyish hairs.

Exarcus.

Oculi rotundati, grosse granulati. *Rostrum* cylindricum, arcuatum; *scrobes* margine inferiore oculi terminatæ. *Antennæ* præmedianæ; *funiculus* gradatim crassior, articulo ultimo discreto. *Prothorax* utrinque rotundatus, lobis ocularibus vix productis. *Scutellum* distinctum. *Elytra* elongata, prothorace paulo latiora. *Abdomen* segmentis duobus basalibus valde ampliatis. *Pedes* breviusculi; *femora* mutica; *tibiæ* intus versus apicem spinosæ; *tarsi* articulo penultimo late bilobo; *unguiculis* divisis.

In *Amalactus* the scrobes are confluent beneath and the tibiæ are of the normal form; the small claw-joint and its parallel claws are among the generic characters given by Lacordaire, but are of the usual size in this genus. The specimen described below has been a long time in my collection, and is interesting as being, so far as I know, the only Asiatic representative of the group. I have named it after the late General Sir John Hearsey, whose energy in the Indian mutiny saved Calcutta from the fate of Cawnpore—a diligent collector of Coleoptera, one of the few English officers who have taken any interest in that part of the Indian fauna, of which we know so little.

Exarcus Hearseyi.

E. anguste oblongus, nitide ferrugineus; prothorace longitudine haud latiore, subtiliter punctato; elytris striato-punctatis, punctis approximatis. Long. 5 lin.

Hab. Rangoon.

Narrowly oblong, glossy ferruginous; rostrum shorter than the prothorax, minutely punctured; funicle with the second joint three times longer than the first, the remainder transverse; club oval, tomentose; prothorax narrowed anteriorly, rounded at the sides, finely punctured; scutellum triangular, black; elytra more than twice as long as the prothorax, striate-punctate, punctures approximate; body beneath and legs glossy dark brown; tibiæ with four or five short spines on the lower half of the inner margin, in the fore tibiæ the first spine triangularly produced.

Camptorhinus turbatus.

C. anguste oblongus, albo-squamosus, nigro-plagiatus; rostro nigro, basi rude punctato; prothorace subgloboso; elytris seriatim foveatis. Long. 4–5 lin.

Hab. North Borneo.

Narrowly oblong, densely covered with white scales, varied with black, nearly scaleless patches; rostrum black, roughly punctured at the base; antennæ ferruginous, club rather broadly ovate; prothorax subglobose, the sides scaly, the middle of the disk black, with a slight raised narrow median line; scutellum oblong, raised, covered with pale silaceous scales; elytra slightly broader than the prothorax, seriate-foveate, the interstices, especially towards the declivity, somewhat raised; legs rather short, covered with white scales, a black ring on the tibiæ; femora with an acute tooth beneath; body beneath covered with smaller grey scales.

This description is from a fresh specimen, in which the white scales clothe the shoulders and posterior portion of the elytra, mounting up the suture; but the proportion of colours seems to be variable. It is a robust species for the genus, with shorter legs &c., the hind femora not extending much beyond the elytra. *Cryptorhynchus notabilis*, Walk., is a *Camptorhinus* closely allied to *C. statua*.

Otidognathus comptus. (Pl. XI. fig. 6.)

O. subellipticus, nitide fulvus; rostrum fere rectum; prothorace basi rotundato, disperse punctato, in medio macula elliptica nigra notato; elytris striato-punctatis, punctis determinatis, interstitiis convexis, subtiliter punctatis; pygidio mediocriter punctato. Long. 4 lin.

Hab. Cambodia.

Subelliptic, tawny yellow, smooth and shining; head and apical half of the rostrum blackish, the latter coarsely punc-

tured, except at the base; prothorax scarcely lobed at the base, punctures very numerous, minute, in the middle an elliptical black spot; scutellum narrow; elytra deeply striate, striæ closely punctured, the interstices convex and finely punctured, each elytron with three round, black, distinct spots—at the base and apex, and an intermediate one near the suture; legs glossy, knees and tarsi black, the rest tawny; body beneath smooth, black, the breast and fourth abdominal segment tawny.

The base of the prothorax is rounded, scarcely showing the vestige of a lobe.

Otidognathus celatus.

O. ovato-ellipticus, supra obscure rufo-ferrugineus, indistincte nigro-plagiatus; prothorace fere impunctato; elytris tenuiter striatis, subtilissime punctatis; pygidio haud carinato. Long. 9 lin.

Hab. Cambodia.

Head remotely punctured; rostrum shorter than the prothorax, glossy ferruginous, except at the base; prothorax finely and sparsely punctured, the base and apex with coarser punctures; scutellum black, the base only punctured; elytra minutely striate and nearly impunctate; pygidium obtuse and finely punctured; body beneath smooth, dark brown; legs glossy ferruginous, the knees and tarsi black, the latter long and very glossy.

Allied to *O. Westermanni*, which, *inter alia*, is a glossy species with a tricarinate pygidium. The colour here is a dull reddish brown, but with indistinct black patches, somewhat cruciform on the prothorax, but with three or four on the elytra, two in one specimen uniting to form a band.

Ommatolampus stigma. (Pl. XI. fig. 8.)

O. elongatus, glaber, niger, nitidus, infra ad latera rufus; elytris subtilissime punctatis, anguste striatis; pygidio apice macula biloba opaca notato. Long. 15 lin.

Hab. Andaman.

Elongate, black, smooth and polished, the sides beneath rufous; rostrum shorter than the prothorax, with two grooves on each side; head and prothorax minutely and sparingly punctured, the latter with a bifid and opaque spot at the base; scutellum scutiform; elytra very minutely punctured, the disk with narrowly linear striæ, the apex and sides velvety opaque brownish black; pygidium with a bilobed somewhat ashy spot at the apex; legs rather short; tibiæ dotted with minute white scales.

The original spelling of this generic name was *Ommatolampes*; but there is nothing in the eye to justify the name. This species will be easily recognized by the spot at the base of the prothorax, as well as the one on the pygidium.

Sphenocorynus meleagris.

S. anguste ellipticus, niger, maculis numerosis annularibus ochraceis notatus; rostro modice elongato, leviter arcuato, basi reticulato-foveato, apicem versus granulato; antennis furfure ochraceo vestitis. Long. 8 lin.

Hab. Sarawak.

Narrowly elliptic, black, speckled with numerous small annular ochreous spots; rostrum comparatively long, slightly curved, the base reticulately pitted, beyond dotted with small granules; antennæ, except at the base of the club, closely covered with an ochreous squamosity; prothorax oblong, nearly parallel at the sides except towards the apex; scutellum small, glossy black; elytra broader than the prothorax, and about a quarter longer, slightly striate; pygidium triangular, obtuse; body beneath obscurely spotted, nearly smooth; femora with smaller spots, hind femora with a small tooth; tibiæ and tarsi with a dense ochreous squamosity.

Larger than *S. pygidialis*, which has a short and nearly straight rostrum. *S. melanaspis* has also a short and stout rostrum, with small scattered punctures, which are nearly obsolete towards the apex, and glossy black antennæ without squamosity.

Sphenocorynus rufescens.

S. anguste ellipticus, sordide rufus, in medio prothoracis vitta nigra notatus; rostro valido, subrugoso; elytris leviter striato-punctatis. Long. 6 lin.

Hab. Tondano.

Narrowly elliptic, dull rufous; rostrum short, stout, roughish; antennæ slightly glossy, rufous; prothorax subconical, slightly incurved towards the base at the sides, minutely speckled with ochreous, a black stripe in the middle and on each side; scutellum dark brown; elytra somewhat broader at the base than the prothorax, and about a third longer, finely punctate-striate, the interstices with a row of minute pale ochreous spots, shoulder and side near the apex with a blackish spot; pygidium oblong, obtuse, slightly punctured; body beneath obscurely spotted; legs rufous.

The rostrum in this species is comparatively stout and some-

what roughish, owing, except at the base, to certain large but shallow and irregular punctures.

Sphenocorynus conformis.

S. anguste ellipticus, rufus, in medio prothoracis vitta nigra notatus; rostro minus valido, versus apicem granulato; elytris leviter striato-punctatis. Long. 6 lin.

Hab. Philippines.

Narrowly elliptic, rufous, with a narrow black stripe in the middle of the prothorax; rostrum comparatively slender, blackish at the tip and granulate, the base with a shallow longitudinal groove and closely punctured, the punctures obscurely ringed; antennæ—except the spongy part of the club—glossy black; prothorax subconical, scarcely incurved towards the base, and sprinkled with shallow inconspicuous punctures, a clear black stripe in the middle; scutellum rounded, black; elytra slightly broader than the prothorax, and about one third longer, striate-punctate, punctures large and approximate, interstices slightly convex; pygidium triangular, obtuse, blackish, and with coarse scattered punctures; body beneath black, the pectus rufous; legs glossy, dark brown or blackish.

Allied to the preceding, but with a differently sculptured rostrum and conspicuously punctured elytra.

Sphenocorynus ocellatus.

S. anguste ellipticus, brunnescens, nigro ornatus, supra punctis ochraceo-annulatis notatus; antennis pedibusque piceis. Long. 7 lin.

Hab. Formosa.

Narrowly elliptic, chocolate-brown, with black and ochreous stripes and spots above; rostrum rather short comparatively, closely punctured, the punctures ringed with ochreous; antennæ pitchy, the spongy part excepted; prothorax subconical, slightly rounded at the sides, a median and a lateral blackish stripe, the latter bordered with ochreous above, the intervals with crowded, and towards the middle confluent, punctures, bordered with ochreous; scutellum small, black; elytra somewhat broader than the prothorax, and about one third longer, finely striate-punctate, punctures approximate, filled with an ochreous squamosity, except the centre, and smaller than those on the prothorax; the shoulder and apex with a black oblong spot, the former smallest and margined with ochreous, and a narrow ochreous stripe nearly in the middle of the disk; py-

gidium punctured and bordered on the sides with ochreous; body beneath nearly smooth, chestnut-brown, the episterna of the metathorax with a dense ochreous squamosity; legs pitchy.

Allied to *S. rufescens*, but readily distinguished by its coloration.

Cercidocerus heros. (Pl. XI. fig. 3.)

C. (♀) robustus, subellipticus, supra depressus, nigro-velutinus et albo-lineatus; elytris humeris antice productis. Long. 9 lin.

Hab. Penang.

Robust, subelliptic, depressed or flattish above, clothed with a black velvety pile with white lines; rostrum much shorter than the prothorax, compressed, glossy black, except at the base; antennæ black, the funicle scaly; prothorax oblong, two narrow white lines from the apex gradually diverging towards the base; scutellum narrowly elongate; elytra finely striate, the apex of each rounded only externally, the shoulders produced and slightly overlapping the base of the prothorax, the basal margin white, with two or three short white lines on the side and others behind the middle and at the apex; body beneath and legs black, sterna and femora clothed with a delicate white pubescence.

This fine species may be placed after *C. indicator*, but the lobed or projecting base of the elytra will at once distinguish it from any other described species. The prothorax is apparently without punctures; but a strong lens shows that they are present. The description is made from a female; the male I have not seen.

Eugnoristus tristis.

E. latiusculus, niger, opacus; prothorace (♂) parum longiore quam latior, ♀ breviore; elytris in utroque sexu paulo latioribus, sed confertim punctatis. Long. $3\frac{1}{2}$–5 lin.

Hab. Madagascar.

Rather broad, opaque black; rostrum slender, glossy, shorter than the prothorax in the male; first and second joints of the funicle equal in length; prothorax almost transverse in the female, larger in the male, rather closely punctured, the base and sides with a border of pale greyish scales; elytra coarsely punctate-striate, the interstices with a row of coarse punctures, a stripe of greyish scales along the suture, passing obliquely to the sides at about a third part from the apex; legs slender; pro- and mesosterna densely covered with greyish scales.

A very distinct species; in *E. monachus* and *niger* the second joint of the funicle is much larger than the first.

Nassophasis pictipes. (Pl. XI. fig. 1.)

N. oblonga, nigra, supra impresso-foveata; femoribus dimidio basali tibiisque rufis. Long. $4\frac{1}{2}$ lin.

Hab. Ceylon?

Head and rostrum coarsely and irregularly punctured, the latter moderately curved; antennæ black, scape extending to the prothorax, club broadly ovate; prothorax longer than broad, the disk with deep irregular foveæ, the intervals between with a few glossy granules; scutellum very narrow; elytra broader than the prothorax at the base, deeply impressed with oblong foveæ—those near the suture in pairs—the intervals irregularly raised, posteriorly two spots composed of a dull greyish squamosity; body beneath black, sparsely punctured; basal half of the femora and tibiæ rufous.

Nassophasis with the facies of *Sipalus* has an uncovered pygidium, obtuse and nearly vertical, therefore not seen from above. In an arbitrary classification, which seems the only practical one in a family which contains so many polymorphous species as the Curculionidæ, I should prefer placing it with the Calandrinæ, although, perhaps, its affinity is more with the Sipalinæ, to which Mr. C. Waterhouse refers it.

Neoxides.

Rostrum rectum. *Antennæ* basales. *Pygidium* horizontale. *Pedes* anteriores longiores; *femora* linearia. *Cæteris* ut in *Megaprocto.*

Zetheus has also linear femora and a horizontal pygidium, but then it has a curved rostrum, and, as a secondary character, a linear outline.

Neoxides bilineatus. (Pl. XI. fig. 4.)

N. elongato-ellipticus, niger, supra indumento nigrescente guttatim ochraceo notatus; prothorace utrinque linea ochracea determinata ornato; elytris quam prothorax vix longioribus. Long. 9 lin. (rostr. incl.).

Hab. Sumatra.

Elongate elliptic, dull blackish with scattered small round ochreous ocellated spots above; rostrum nearly straight, dark ferruginous, with several small glossy tubercles; antennæ ferruginous; first joint of the funicle stoutish, the second equal in length; prothorax nearly as long as the elytra and as broad, the disk on each side with a well-defined ochreous line; scutellum rounded at the apex; elytra gradually narrower from the base, each posteriorly with a transverse ochreous ringed spot with a dark centre; pygidium elongate, acute,

with ochreous-ringed punctures, each with a white recumbent seta; body beneath and legs mostly closely spotted with an ochreous pile; the femora armed with a small acute but conspicuous tooth beneath.

Laogenia laticollis. (Pl. XI. fig. 2.)

L. angusta, obovata, nigrescens; prothorace valde ampliato, utrinque rotundato; elytris subcuneiformibus. Long. 4 lin.

Hab. North Borneo.

Narrowly obovate, blackish; rostrum (♂) granulated on each side; antennæ somewhat pitchy; prothorax very broad, the middle longitudinally concave, closely punctured, each puncture filled with a pale yellowish scale; scutellum nearly round; elytra much narrower than the prothorax and a little longer, subcuneiform, striate-punctate, the punctures quadrate and approximate, interstices narrow; pygidium triangular; fore legs longest, their tibiæ bearded internally.

The prothorax is much broader and more rounded at the sides than in the other species, except *L. intrusa*, which, with a much narrower prothorax, has the elytra more nearly parallel at the sides.

Tyndides luctuosus. (Pl. XI. fig. 5.)

T. ellipticus, nigro-velutinus, lineis pallide ochraceis conspicue ornatus; rostro dimidio apicali nigro, nitido; tarsis posticis elongatis. Long. $8\frac{1}{2}$ lin. (rostr. incl.).

Hab. North Borneo.

Elliptic, clothed with a black velvety pile varied with white stripes or lines; rostrum glossy black; the basal half and anterior border of the prothorax crowded with impressed punctures filled with a ring of ochreous scales; antennæ moderately long; prothorax conical, half as long again as its breadth at the base, a broad irregular ochreous stripe on each side; scutellum short, black, glabrous; elytra rather longer than the prothorax, seriate-punctate, punctures rather large, but on the black portion not very evident, the base, suture, and sides bordered with ochreous, and a narrow, flexuous, transverse band of the same colour behind the middle; pygidium black with three ochreous stripes; body beneath black, sides of the sterna ochreous; legs closely dotted with ochreous scales.

A well-marked species, but agreeing generically with the two species recorded by me in the 'Journal of the Linnean Society,' xii. p. 68. A strict application of the character of a straight rostrum leads me to transfer *Prodioctes amœnus* to *Tyndides*, but it has the coloration of several species, scarcely

congeneric, which cluster round *Sphenophorus Dehaanii*, Gyll. My *Megaproctus pugionatus*, for the same reason, must be removed from the genus to which I have referred it, supposing its horizontal pygidium to be, as Lacordaire asserts, a character of generic importance.

Rhina Meldolæ.

R. angusta, nigra; rostro bifariam denticulato; prothorace reticulato-punctato; elytris striato-punctatis, punctis quadratis, interstitio tertio squamositate ochracea interrupte vestito. Long. 5–7 lin.

Hab. Andaman.

Narrowly oblong, black, a conspicuous stripe on each elytron, and a series of linear spots on the side composed of an ochreous squamosity; rostrum shorter than the prothorax, denticulate above on each side; antennæ median in the male, subbasal in the female, the club broadly ovate; prothorax longer than broad, coarsely reticulate-punctate; scutellum triangular; elytra not broader than the prothorax, striate-punctate, punctures quadrate (larger at the sides), interstices convex, the third with a slightly interrupted linear stripe; pygidium covered; body beneath and legs dotted with punctures, each bearing a pale scale; anterior tibiæ curved, the inner margin not spinose, but fringed with long ferruginous hairs in the male.

This species agrees with the St. Domingo *R. scrutator*, Ol., in facies and in having the anterior tibiæ without spines and ciliated in the male, but differs in sculpture and in having a short broadly ovate club, &c. I owe my specimens to Prof. Meldola, F.R.S., who found them and other interesting forms at Port Blair.

EXPLANATION OF PLATE XI.

Fig. 1. *Nassophasis pictipes.*
Fig. 2. *Laogenia laticollis.*
Fig. 3. *Cercidocerus heros.*
Fig. 4. *Neoxides bilineatus.*
Fig. 5. *Tyndides luctuosus.*
Fig. 6. *Otidognathus comptus.*
Fig. 7. *Dinichus terreus.*
Fig. 8. *Ommatolampus stigma.*

XLVIII.—*Note on two Species of Lucanoid Coleoptera, allied to* Cladognathus bison. By Charles O. Waterhouse.

The British Museum has recently acquired an interesting series of Coleoptera from the Salomon Islands, collected by Mr. C. M. Woodford. Among them is a fine series of a *Cladognathus* allied to *C. bison.* In the Museum collection there is a good series of another species from Cape York, Torres Straits (Thursday I., Murray I., and Cornwallis I.), and New Guinea. These three species closely resemble each other in general form and colour; but *C. bison* is easily distinguished from the two others by its having reddish-yellow spots on all the femora and often on the sternum. The two other species are extremely alike, with nearly uniformly coloured legs; those from the Salomon Islands, however, have the femora more castaneous than the species from Torres Straits.

I am in doubt which of these two species is to be referred to *C. cinctus*, Montr., from Woodlark I.; but the proximity of Woodlark I. to the Salomons, and the fact that Montrouzier states that the large males of *C. cinctus* have five or six teeth on the inner side of the mandibles, incline me to believe that the Salomon-Islands species is the true *C. cinctus.* The species from Torres Straits I propose to call *C. limbatus.*

Cladognathus limbatus, n. sp.

General form and colour of *C. bison*; nearly black, with the elytra and sometimes the thorax dark pitchy brown. The larger males with the sides of the thorax yellowish (with a black spot in the middle of the yellow); the smallest males and the females with a reddish-yellow crescent-shaped mark at the sides. The elytra with a broad margin of yellow, as in *C. bison*, but narrowed at the extreme apex as it approaches the suture. Legs black. The large males have two teeth beyond the middle of the mandibles, with the apex furcate; the smaller males have the mandibles serrate. Thorax with the posterior angles sinuate.

♂. Length (with the mandibles) 10–24 lines.
♀. " " $11\frac{1}{2}$–16 "

This species differs from *C. bison* in having the legs uniform black. The mandibles of the large males have much fewer teeth, and the yellow band of the elytra narrows as it reaches the suture. The large triangular tooth at the base of the mandibles appears also to be much more simple.

The species from the Salomon Islands, which I believe to be the true *C. cinctus*, differs from *C. limbatus* in the males

having the yellow marginal band of the elytra not narrowed at the apex. The large males have four or five teeth beyond the middle of the mandibles (besides the apical furcation); the large triangular tooth at the base of the mandibles is relatively longer, straight on its inner margin (not curved in at its apex), and denticulate. The females are very difficult to distinguish from those of *C. limbatus*; the lines of punctures on the elytra are, however, more distinct. The metasternum is dull in both species; in *C. limbatus* there are numerous shallow horseshoe punctures, which become crowded together at the side next to the epipleura. In *C. cinctus* these punctures are more sharply defined and round, and not confluent, except perhaps a single line next to the epipleura.

In the late Major Parry's Catalogue of Lucanidæ (Trans. Ent. Soc. Lond. 1864, p. 22) there is the following note respecting *C. cinctus*:—

"This species is also, according to Mr. Wallace, found in the islands of New Guinea, Ki, and Arou, and must be considered as very questionably distinct from *C. bison*, differing in having the four posterior femora black beneath, and the anterior with a small rufous spot, whereas in *C. bison* the rufous patch exists on all the femora."

Two examples from Major Parry's collection are now in the British Museum; one of these (from Cape York) is *C. limbatus*, the other (without locality) is a variety of *C. bison*. The statement that *C. cinctus* differs from *C. bison* in having a red spot only on the front femora appears to have arisen from a misunderstanding of Montrouzier's description. He mentions no red spot, but "une tache fauve, doré sur le devant des cuisses antérieures," which clearly refers to a spot of golden pubescence, usual on the *front* of the femora, and not to a red spot on the back of the femur.

XLIX.—*Descriptions of two new Species of* Coptengis (*Coleoptera*, Erotylidæ). By Charles O. Waterhouse.

The British Museum has received two species of the genus *Coptengis* which appear to be undescribed, and for which I propose the names *C. Curtisii* and *C. Melvilli*.

Coptengis Curtisii.

Purpureo-cuprascens, nitidissimus, immaculatus; pedibus viridiæneis.

Long. 19–22 millim.

This species is closely allied to *C. Sheppardi*, but is distinguished at once by its totally different colouring (being of

a dark purple-coppery colour) and by the much more delicate and less close punctuation of the thorax and elytra.

Hab. Batchian (*C. Curtis*).

Coptengis Melvilli.

Læte cyaneus, nitidissimus; elytris maculis quatuor flavis notatis. Long. 19 millim.

Closely resembles *C. Sheppardi*, but is of a deep blue colour, the legs being also blue. Besides the difference in colour, this species is distinguished by the punctuation of the elytra, which is as strong as in *C. Sheppardi* but less close.

Hab. New Guinea.

Presented to the Museum by J. Cosmo Melvill, Esq.

L.—*Remarks on Dr. A. Strauch's Catalogue of the Geckos in the Zoological Museum of the Imperial Academy of St. Petersburg* *. By G. A. Boulenger.

This important memoir contains an enumeration of all the Geckoid Lizards (inclusive of the Eublepharidæ and Uroplatidæ, which are united with the Geckonidæ) in the St. Petersburg Museum. We learn that 122 species are represented in that collection by upwards of 637 specimens. A dichotomical key is given of all the genera, but only such species as are new or imperfectly known are described. The author has not adopted the sequence followed in the British-Museum Catalogue, in which the series of genera commences with the least specialized forms, *i. e.* those in which the digits are not dilated; he prefers commencing with the most "typical" forms, in which the Geckoid character is most highly developed. Two new genera are established, viz. *Cnemaspis*, allied to *Gonatodes*, for a new species from Pulo Condor, and *Ptenodactylus*, allied to *Stenodactylus*, for a Turkestan form, *P. Eversmanni*, Wiegm., which had never been properly described before. Twelve other new species are established, on three of which I have to offer some remarks.

First with respect to the new *Gehyra*, *G. Fischeri*, from Ternate; I am inclined to think that this is a young male of the same form that I described, almost simultaneously, from an adult female from Morty, and named *G. marginata*. The volume in which I published its description having been

* "Bemerkungen über die Geckoniden-Sammlung im zoologischen Museum der kaiserlichen Akademie der Wissenschaften zu St. Petersburg," Mém. Acad. St. Pétersb. xxxv. no. 2, 1887.

issued on March 26, 1887, and the Russian memoir, as I understand from a communication of Dr. Strauch, not before the 1st of April, the name *G. marginata* will, if my identification proves correct, have a few days' priority.

In the genus *Tarentola*, of which the author gives a synopsis of all the species hitherto described, two new ones are established under the names of *T. neglecta* and *T. angusticeps*, each based upon a single specimen from Batna, Algeria. With these, or rather with this new species, for I regard *T. neglecta* and *angusticeps* as individual variations of one and the same form, I have been acquainted for the last two years, three specimens, from the Algerian Sahara, having been presented to the Natural-History Museum by M. Lataste in March 1885; but their donor having expressed his intention of describing the new species, I had put them aside awaiting his publication, and therefore no mention is made of them in the Appendix to the third volume of the 'Catalogue of Lizards.' I will retain for the species the name *T. neglecta*. The presence or absence of a faint keel and the degree of convexity of the head-scales are most unsatisfactory characters for separating species in the genus *Tarentola*. The Natural-History Museum possesses specimens of *T. mauritanica* with distinctly though feebly keeled upper head-scales, and of our three specimens of *T. neglecta* two have them keeled, the other not. Before leaving the genus *Tarentola* I must express my regret at seeing the Linnean name *mauritanica* rejected in favour of Aldrovandi's *facetana* (1663). With the majority of modern systematists, I hold that the right of priority, in binomial nomenclature, should not extend back beyond Linnæus's twelfth edition of the 'Systema Naturæ' (1766). In the case of the species of *Teratoscincus* Dr. Strauch disregards the rule of priority in favour of his name *Keyserlingii* (1863), against that of *scincus* (Schlegel, 1858), simply remarking that there is no sufficient ground for giving preference to the latter. Schlegel's little book 'Handleiding tot de Beofening der Dierkunde' (ii., 1858), not being much known, I cannot do better than reproduce the description by which he has unquestionably secured priority:—

"*Kamvingers* (*Stenodactylus*).—Vingers sonder schijven, maar van onderen met gevone, ter weêrszijde met eene rij van, als stekeljes verlengte, schubben bekleed. Zij leven op zandgroden in Afrika en Asië. De gewone soort, *Stenod. guttatus*, bewoont Noord-Afrika. Eene andere, *Stenod. scincus*, wijkt van alle overige Gekko's daardoor af, dat haar romp en staart met zeer groote, elkander op de wijse van dakpannen over-

dekkende schubben, bedekt zijn. Zij bewoont de zandige oevers der Ili-rivier, ten oosten van Turkestan."

Dr. Strauch's contribution is preceded by a lengthy introduction, in which he reviews the recently-published 'Catalogue of Lizards' in the British Museum. After some flattering remarks on the general character of the work, by which, coming from so high an authority, I feel much honoured, an *attaque en règle* is directed against the classification which I have proposed. I can well understand that the principles which have guided me in the formation of the primary groups of the order Lacertilia do not meet with Dr. Strauch's approval. The celebrated Russian herpetologist has always been averse to the introduction into systematic zoology of any but purely external characters. But this does not meet the requirements of modern science. In this case he again proposes to revert to the classification of Wiegmann and Duméril and Bibron. It would occupy too much space were I to discuss all the points in which we differ as to the relationships of Lizards, and it must be left to those who devote themselves to a study of that order, not based merely on epidermic characters, to judge which of Dr. Strauch's or my views on the classification is the nearest approach to nature. But there are some points in Dr. Strauch's criticism which I cannot leave unanswered.

First of all, objection is made from a purely practical point of view to the introduction of osteological characters in classification. How is the family to which a specimen belongs to be determined without injuring or partly destroying it? How is a beginner to find out to which group any given specimen is to be referred? Now I have already remarked, in my introduction to the 'Catalogue of Batrachia,' that a specimen need not be sacrificed to make out the few osteological characters which seem to be of systematic value. A few slits, made here and there with a little skill, are usually quite sufficient for the purpose. By simply feeling with the finger on a complete specimen it is, in most cases, easy with a little experience to make out the presence or absence of a bony supratemporal roof, of postorbital and supratemporal arches, of bony dermal scutes, or of a supraorbital bone (which latter character appears to have so greatly puzzled Dr. Strauch in the case of the genus *Tarentola*). Nor do I consider that classifications are made for the convenience of beginners. Before engaging in systematic work a beginner must make himself acquainted with the elements of Lacertilian osteology. For this purpose a set of eight skeletons, which he will find in any museum, or can easily have prepared, or can procure

from any dealer in zoological specimens, will suffice. This set, I would suggest, may consist of the following skeletons:—

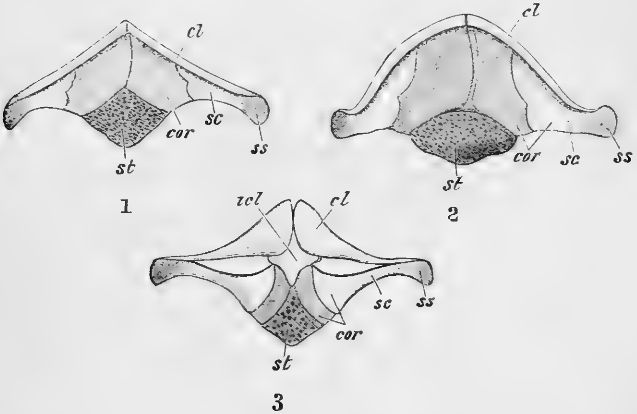
1. A Gecko (any common species, such as *Tarentola mauritanica* or *Gecko verticillatus*); 2, an Agamoid (*Calotes* or *Uromastix*) or an Iguanoid (*Iguana*); 3, a Slow-worm (*Anguis fragilis*); 4, a *Varanus*; 5, an *Ameiva* or a *Cnemidophorus*; 6, an *Amphisbœna*; 7, a Scincoid (*Chalcides ocellatus* or *Eumeces algeriensis*, or any other common species); 8, a Chameleon. When he is acquainted with the structure of these eight types he will have no difficulty in understanding the diagnoses of the families as expressed in the Catalogue of Lizards. If external characters are solely to be relied upon I would ask my critic the reason why *Teratoscincus* should not be a Scincoid (in the sense in which he takes that family), and how a typical Teioid is to be distinguished (so far as the family characters are concerned) from a Lacertoid? Dr. Strauch is entirely mistaken in the estimate he makes of the number of species which have been examined by me as to their osteological characters, probably owing to his reckoning only the prepared skeletons enumerated in the Catalogue; and especially in the case of *Æluroscalabotes* I am surprised at his believing that so peculiar a type should have passed without investigation at my hands. I may state that *Æluroscalabotes* has the parietal bones distinct and the vertebræ amphicœlian, and that consequently he entirely spoils my family Eublepharidæ, a most natural association, by adding that genus to it.

Passing to the intrinsic value of the characters employed by me for classification, apart from practical considerations, Dr. Strauch declares the result attained to be unnatural save in the points on which I have adhered to old-accepted ideas. He particularly objects to the introduction of the character of the shape of the clavicle in the definition of families, on the ground that the organ is not present throughout the group, disappearing in some of the limbless forms. I have, however, in the synopsis of the families which heads the first volume of the 'Catalogue,' made the restriction "clavicle present *whenever the limbs are developed*." As the character of the clavicle is accompanied by a combination of others which must be regarded as of systematic importance, it is quite feasible and within the limits of scientific induction, by deriving certain degraded forms from types in which the pectoral arch is fully developed, to incorporate them in the group characterized by a definite form of clavicle; in the same way as the class Batrachians is usually characterized, in opposi-

tion to that of fishes, by the structure of the limbs, although limbless forms occur in both classes. Dr. Strauch proposes instead to group together the degraded forms; but I must urge that to me they seem to be the ends of diverging series of forms. This explanation answers also Dr. Strauch's objection that I have mixed up the families at random; it has never been in my mind to form a continuous linear series of families; contrary to what Dr. Strauch appears to think, I believe such a work to be impossible.

Dr. Strauch is at a loss to find the reason why the Pygopodidæ are placed among the forms with non-dilated clavicle. "Ferner ist es mir nicht gelungen," he says, "zu eruiren, welchem Princip Herr Boulenger bei Bestimmung der Reihenfolge für die einzelnen Familien seiner Unterordnung *Lacertilia vera* gefolgt ist, und was ihn z. B. bewogen hat, die Familie Pygopodidæ, deren Repräsentanten bekanntlich keine Vorderextremitäten und folglich auch kein Schlüsselbein besitzen, gerade zu der Gruppe mit einfacher, am proximalen Ende nicht erweiteter Claviculen zu rechnen." The reason is simply that, in spite of the absence of fore limbs, the Pygopodidæ have a clavicle which is not dilated proximally, and that they present the characters enumerated in the heading of the group alluded to.

I append the following figures which represent the shape of the clavicle in the Pygopodoid genera *Pygopus* and *Lialis*



Pectoral arch of

1. *Pygopus lepidopus.* (After Fürbringer.)
2. *Lialis Burtonii.* (Ditto.)
3. *Lygosoma præpeditum,* an apodal Scincoid from Australia.

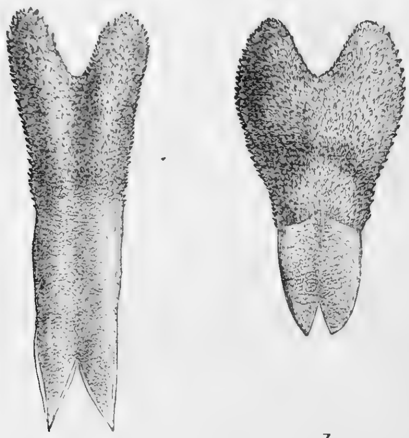
cl, clavicle; *icl,* interclavicle; *cor,* coracoid; *sc,* scapula; *ss,* suprascapula; *st,* sternum.

and in an apodal Scincoid; they are sufficient to show that even in these limbless forms this organ affords a good systematic character.

My nameless groups are only established in the key to the families simply to facilitate the determinations and to avoid useless repetition; had I considered them natural groups I would have bestowed names upon them.

The family Anguidæ, as defined in the Catalogue, appears to Dr. Strauch a most unnatural association. Here, however, the osteological characters are accompanied by striking external ones, which Dr. Strauch, like most of his predecessors, appears to have overlooked. I will only allude to the wonderful similarity in the scaling of the head of *Anguis* and *Ophisaurus* (*Pseudopus*), unlike anything to be found in the family of Scincs, and to the fact that the scales of the sides of *Anguis* are arranged in straight transverse series, and not quincuncially, a fact already noticed by Leydig (Deutschl. Saur. 1872).

I fail to understand how it can be proposed to place *Heloderma* and *Anguis* in two suborders, the former in the Pachyglossa, the latter in the Leptoglossa. The following figures, carefully executed from nature, will allow the reader to judge for himself:—



a   b

a. Tongue of *Heloderma horridum* (one of Strauch's Pachyglossa).
b. Tongue of *Anguis fragilis*, enlarged (one of Strauch's Leptoglossa).

BIBLIOGRAPHICAL NOTICES.

The Structure and Life-history of the Cockroach (Periplaneta orientalis), *an Introduction to the Study of Insects.* By L. C. Miall and Alfred Denny. 8vo. London, Lovell Reeve and Co.; Leeds, Jackson. 1886.

In this volume on the Cockroach, which is No. III. of Prof. Miall's 'Studies in Comparative Anatomy,' we have another book written chiefly for the use of college pupils, but which may be of great service to students of Natural History. Starting with a short account of the systematic position and habits of the Cockroach, the authors proceed to describe its structure in considerable detail, working in here and there references to the general structure of Insects brought into correlation with the facts revealed in the direct investigation to which the book is specially devoted, such as a comparison of the parts of the mouth, of the structure and development of the wings, of the nervous system and organs of sense, and of the organs of circulation and respiration in the Cockroach and other insects. It will be easily seen that from these points of view much may be learned from a careful examination of the phenomena presented by any one type of insect and a judicious generalization of the facts thus demonstrated by comparison with other forms, and perhaps no better type than the Cockroach could well have been selected to serve as a starting-point for such an investigation. It represents one of the earliest known types of winged insects, and certainly makes the nearest approach of any easily accessible form to what may be regarded as the lowest development of insect-life.

The student of entomology who follows the authors in their investigation of the anatomy of this domestic pest will certainly find himself in a position to take up with great advantage the study of representatives of other groups of insects. At the same time he must not regard the present work as by any means an exhaustive treatise. Fully recognizing the value of the work done by the authors, we cannot but feel that in the general treatment of the subject there is a want of something, which something would seem to be a sound appreciation of the zoological aspects of the subject, a deficiency which appears to be foreshadowed by a passage in their preface, where they say, "It is our belief and hope that naturalists will some day recoil from their extravagant love of words and names, and turn to structure, development, life-history, and other aspects of the animal world;" for while we can quite agree with them in wishing for such a consummation, we read here, perhaps, between the lines a faint trace of the want of appreciation of the merits and purpose of systematic Natural History, which seems to us to lie at the root of the deficiencies of this otherwise excellent book.

In the chapter on the development of the Cockroach the authors have availed themselves of the aid of Mr. Joseph Nusbaum of War-

saw, who has furnished them with an elaborate description of the embryonic development of *Blatta germanica*, while Mr. S. H. Scudder has contributed a sketch of the geological history of the Blattidæ. The volume is illustrated with a number of woodcuts, generally well executed, which will be found most useful to the student; in fact, the book must be regarded as a most valuable contribution to the practical literature of zoology.

Exotische Schmetterlinge. Abbildungen und Beschreibungen der wichtigsten exotischen Tagfalter in systematischer Reihenfolge mit Berücksichtigung neuer Arten, von Dr. O. STAUDINGER, unter technischer Mitwirkung von Dr. H. LANGHAUS (1–16 Lieferungen). II. Theil. *Die Familien und Gattungen der Tagfalter systematisch und analytisch bearbeitet*, von Dr. E. SCHATZ (1, 2 Lieferungen). Folio. G. Löwensohn: Furth (Bavaria), 1884–86.

IN the present work Dr. Staudinger has successfully attempted to supply a want which all collectors of exotic butterflies have felt severely, especially at the beginning of their studies. Hitherto there has been no work, at a moderate price, containing a large number of fairly-recognizable coloured figures of foreign butterflies in systematic order. The older illustrated books, few of which are at all systematic, are not only expensive, but are becoming scarcer and dearer every day; and it is not every one who can refer to an arranged collection. Dr. Staudinger's work is to contain 100 large plates, 80 of which are now before us, and each plate contains from two to nineteen figures, representing all the principal genera and a large number of species. It has been the author's aim to make his work as useful as possible, and he has not excluded remarkable species because they are common, nor has he omitted to include a number of rare and new species which have not previously been figured. The figures are fairly recognizable throughout, and are often excellent, and the standard is well kept up, the later plates being often superior to the earlier ones.

Dr. Staudinger has not discussed generic characters &c., but has left everything beyond the description of species to be dealt with in the companion work of Dr. Schatz, two parts of which have at present appeared, out of six, which are to complete the work. Dr. Schatz discusses classification, geographical distribution, colour, neuration, and generic characters, and proposes some slight improvements in classification. The plates of this portion of the joint work are plain, and represent with great clearness the neuration of the wings in each genus, and other generic characters, such as antennæ, palpi, tarsi, claws, anal appendages, scales, &c. The characters are thus rendered very obvious, and the very doubtful propriety of retaining the genus *Pseudopontia* of Felder, which many good authorities regard as a Liparide moth, among the Pieridæ becomes visible at a glance.

If we desired to be hypercritical it might be easy to pick out

errors in these works (for no Entomological work, at least of any extent, can be expected to be free from them); but we may fairly give the authors and publisher the credit of having produced two works which will be a great boon to all students of Lepidoptera.

W. F. K.

Guide to the Galleries of Reptiles and Fishes in the Department of Zoology of the British Museum (Natural History). Demy 8vo. Printed by order of the Trustees, 1887.

A General Guide to the British Museum (Natural History), Cromwell Road, London, S.W. 8vo. Printed by order of the Trustees, 1887.

The authorities of the British Museum at South Kensington are certainly taking the best possible course to render the splendid collections under their charge available for the instruction of the people. Dr. Günther has followed up the Guide to the Mammalia with one dealing with the Reptiles, Batrachians, and Fishes. There is wanting only a guide to the collection of Birds to complete the series of vertebrate animals. Let us hope that the invertebrate classes may speedily receive a similar attention on the part of the zoological officers, and we may then have a series of text-books, forming together a popular manual of zoology, which will possess a special value as being founded directly upon magnificent collections which are accessible to every one. The cost also will be exceedingly moderate—in the present case purchasers get for sixpence a book of over 120 pages, illustrated with 101 good woodcut figures, and a plan of the galleries the contents of which are here described.

Excellent as the present Guide-book may be, there are one or two points in which we think it is decidedly susceptible of improvement. One of these is the equalization, or more properly coordination, of the general statements as to the structural characters of various groups. Thus the "General Notes" on Reptiles occupy about two and a half pages and those on Batrachians about the same, while over eleven pages are devoted to the general description of Fishes; and valuable as such particulars are to the student, we do not think the names of all the bones forming the Teleostean skeleton will be of much interest to those for whom this Guide is specially intended. At the same time in order to realize that vision of a cheap popular zoological handbook in which we have indulged above, we would rather see this and the corresponding sections relating to other groups judiciously enlarged than the generalities on the class of Fishes cut down. It would also be advantageous and would not occupy much space if these parts of the book could be made to give the reader some hints upon the comparative morphology of the groups, so as to lead him, when inspecting the collections, to recognize the way in which such multifarious results arise from the modifications of the same fundamental plan. The great quantity of classificational names with which this Guide-book bristles seems to be a misfortune;

but we hardly see how it is to be entirely removed. In the case of the names of classes and orders indeed it would be easy to indicate what the words actually signify; but the much more numerous family names cannot be treated in this way, and they furnish the worst examples of "hard words." Fancy an unfortunate visitor to South Kensington, innocent of Greek, finding within a line and a half two such names as "Amphignathodontidæ" and "Ceratobatrachidæ"!

Prof. Flower, in arranging the General Guide to the Museum, has had no such difficulties to contend with as the one just mentioned. His task was a comparatively simple one; but he has executed it in such a manner as to produce a most admirable guide to the building the contents of which are under his charge, while at the same time it will serve for the correlation of the separate guides, to one of which we have called attention above. He commences with an historical account of the foundation and progress of the British Museum down to the removal of the collections to their present abode, and finally notices, seriatim, the various groups of objects exhibited, in the order of the galleries in which they are to be found. To aid the visitor in finding out where he is and in what direction to move in the labyrinth of rooms and galleries the book is illustrated with elaborate plans of the different floors, and on the whole no better guide to such an establishment could be desired. In the nomenclature of the objects popular terms are generally adopted, and when the names of classes or orders have to be employed, they are generally explained.

MISCELLANEOUS.

On the Term Muelleria *as applied to a Genus of Holothurians.* By F. JEFFREY BELL, M.A.

HOWEVER reluctant one may be to perform the most disagreeable and thankless of the duties incumbent on a zoologist, there are times and occasions when one must propose the change of a generic term. The visitor to the Starfish Gallery of the Natural-History Museum who consults the index to the new popular guide to that gallery and to the collection of Mollusca will learn that the *Muelleria* he finds among the Holothurians is a freshwater oyster! The claims of Férussac (1823), who has ten years priority over Jaeger (1833), are such that the Holothurian must have a new name: as *Jaegeria* does not appear to be in use, and as its adoption will probably lead to less confusion than any other name, while, lastly, it will give us the opportunity of honouring a very thorough worker at Holothurian organization, I venture to propose *Jaegeria* to replace *Muelleria*, Jaeger; the definition of the genus will remain as in the latest monographs. I cannot but regret that the authors of two recent valuable monographs on the class generally should have left this little, but not unimportant, point uncorrected.

On the Pteromalinæ of the Hessian Fly. By Prof. K. Lindeman.

Prof. Lindeman has laid before the Society of Naturalists of Moscow an interesting account of the Pteromaline parasites which he has bred from puparia of the Hessian fly obtained from various parts of Russia. He contrasts the species observed by him with those recorded by Riley † in North America, as follows:—

In North America.	*In Russia.*
1. Merisus destructor, *Say.* }	1. Merisus intermedius, *Lind.*
2. —— subapterus, *Ril.* }	2. Tetrastichus Rileyi, *Lind.*
3. Tetrastichus productus, *Ril.*	3. Eupelmus Karschii, *Lind.*
4. Eupelmus Allynii, *French.*	4. Platygaster minutus, *Lind.*
5. Platygaster Herrickii, *Pack.*	5. Semiotellus nigripes, *Lind.*
	6. Euryscapus saltator, *Lind.*
	7. Platygaster? sp.

The Russian species he tabulates as follows:—

1. Winged.	
a. From one to four joints of the flagellum narrowly annular.	
* Flagellum nine-jointed	*Semiotellus? nigripes.*
** Flagellum ten-jointed.	
a. Antennæ with a distinctly two-jointed club	*Tetrastichus Rileyi.*
β. Antennæ not clavate.	
Flagellum with one annular joint	*Eupelmus Karschii.*
Flagellum with two annular joints	*Merisus intermedius.*
b. No narrowly granular joints in the flagellum	*Platygaster minutus.*
2. With rudimentary wings	*Merisus intermedius,* var. *microptera.*
3. Wingless	*Euryscapus saltator.*

Merisus intermedius is so called because it appears to be intermediate between the two American species *M. destructor* and *subapterus*, which were formerly regarded as forming one species. Its colour is metallic green; the antennæ of the male yellow, of the female brown; legs yellow, with the coxæ, and sometimes also the femora, black; under surface of abdomen often reddish brown, especially at base. Both male and female may have stunted wings, but these are longer than in *M. subapterus*, and show venation. Length 2 millim. The species appears to be very abundant in all parts of Russia, and seems to have two generations in the course of the summer.

Tetrastichus Rileyi is rather less than 2 millim. long; black, with a blue or green lustre. Antennæ blackish brown; legs yellow, with the tips of the tarsi dark; abdominal segments densely hairy, especially towards the apex. *Tetrastichus productus* is regarded by Riley as a parasite of *Merisus*; the author has been unable to arrive

† "On the Parasites of the Hessian Fly," in Proc. U. S. National Museum, vol. viii. (1885) p. 413.

at any conclusion as to whether his species is a primary or secondary parasite of the Hessian fly.

Semiotellus (?) *nigripes* is a form which does not appear to have its representative in North America. It has a strong green, or sometimes blue, metallic lustre, the antennæ and legs black, the latter with greenish lustre, the tarsi pale yellow at the base. Length 2 millim. The species is widely distributed in Russia. It appears to be single-brooded, emerging in July and August.

Eupelmus Karschii is black with a green or blue lustre; antennæ black; legs yellow, with the tips of the femora and tibiæ and the last joint of the tarsi black. In the female the fore legs are entirely yellow. Length under 2 millim. The American species is recorded by Riley as a parasite of *Isosoma hordei* and *I. tritici*.

Platygaster minutus.—Length $\frac{1}{2}$ millim. Black, shining, but with no metallic lustre. Legs yellow, with black femora, and the posterior tibiæ black; wings large, extending far beyond the tip of the abdomen, veinless, but hairy; femora much thickened in the middle, tibiæ in their lower half. The species seems to be abundant. The author regards it, as also the much larger American *P. Herrickii*, as a direct parasite of the larva of the Hessian fly, and not as parasitic in the egg; he always reared it from the puparia, and obtained from four to eleven individuals from a single puparium.

Euryscapus saltator is wingless, black, with a green lustre on the head and thorax, and frequently a brownish spot on each side of the mesonotum. Abdomen black with a faint greenish lustre; legs yellow, with the femora, the middle of the tibiæ, and the tips of the tarsi rather darker; first segment of the abdomen reddish brown; ovipositor yellow with the tip black; scape yellowish brown; flagellum black or dark brown, with a greenish lustre on the first two joints. Length 2 millim. The author has bred this species from puparia of the Hessian fly and also from galls of *Isosoma hordei*, but it does not seem to be abundant.

A single specimen of a seventh species has been obtained by the author. It appears to be a *Platygaster* of about the same size as the one already noticed, black, with yellow legs and brown antennæ, which have a large black club; the wings are as in *Platygaster*.—*Bull. Soc. Imp. Nat. Moscou*, 1887, no. 1, pp. 178–192.

On the Power of Multiplication of the Infusoria Ciliata. By M. E. Maupas.

The author notes that the power of multiplication of the Ciliata depends upon three factors, namely:—1, the quality and abundance of food; 2, temperature; 3, the biological adaptation of each species as regards alimentation. The third factor alone varies for each type, the organization of the buccal apparatus determining the kind of food necessary, and rendering the animalcules herbivorous, carnivorous, or omnivorous.

Cryptochilum, *Paramæcium*, *Colpoda*, *Tillina*, *Colpidium*, and the Vorticellidæ are herbivorous, living almost exclusively upon Schizomycetes and small zoospores. These Infusoria are great purifiers of

foul water. A few *Paramœcia* placed in a drop of water swarming with Bacteriæ, Vibrios, Bacilli, and other microbes will render it in a few hours as pure and clear as spring water. The Stentors, *Euplotæ*, and many Oxytrichidæ are omnivorous, and live upon Schizomycetes and small Infusoria drawn in by their vortices. *Enchelys*, *Didinium*, *Lacrymaria*, *Leucophrys*, the Trachelidæ, and *Coleps* are carnivorous, although some of them can feed upon Schizomycetes in the *Zooglœa*-state.

In small aquaria with infusions the species of Ciliata appear successively in a nearly constant order explicable by their peculiar alimentary adaptation. At first the herbivorous species, finding an abundance of Schizomycetes, swarm and clear the water of those microphytes. Then come the Carnivora, which pursue and exterminate the herbivorous forms.

Stylonychia pustulata has been particularly studied by the author, who followed day by day two separate cultures of it, during more than three hundred successive generations, which lasted rather more than eight months. Under the most favourable conditions of nutrition this species divides once in twenty-four hours at a temperature of 44°–50° F., twice at 50°–59°, three times at 59°–68°, four times at 68°–75°, and five times at 75°–80°. In the last case one individual will produce thirty-two in twenty-four hours; and thus at a temperature of 77°–79° F. a single *Stylonychia* may produce a million of descendants in four days, a billion in six days, and one hundred billions in seven and a half days. The author estimates that the body of a *Stylonychia* has a volume of 100,000 cubic micromillimetres; hence it would take ten thousand to make 1 cubic millim. and a million to 1 cubic centim. Protoplasm being about equal in density to water, a million *Stylonychiæ* will weigh 1 gram, a billion 1 kilogr., and one hundred billions 100 kilogr. Thus a single *Stylonychia* may produce 1 kilogramme of protoplasm in six days and 100 kilogrammes in seven and a half days.

These numbers are obtained when the *Stylonychiæ* are abundantly nourished with small Infusoria, but with vegetable food the rapidity of multiplication and the size of the animals are considerably reduced.

Stylonychia mytilus has less power of multiplication than *S. pustulata*. At a temperature of 42°–48° it divides only once in two days, at 50°–57° once a day, at 59°–64° twice, and three times at 66°–77°.

Euplotes patella requires a temperature of 59°–68° to divide once, and of 68°–75° to divide twice in twenty-four hours. *Onychodromus grandis* divides once in two days at 41°–44°, once a day at 48°–53°, and twice at 55°–64°. *Oxytricha fallax* twice at 57°–61°, and three times at 62°–64°. *Stentor cæruleus*, of which the fission was observed for a month, divides once a day at 75°–79°; and *Spirostomum teres* once in two days at 61°–64°.

Paramœcium aurelia divides once in twenty-four hours at 57°–62°, and twice at 64°–68°; *Paramœcium caudatum* once at 59°–63°; and *Paramœcium bursaria* once in two or three days at 55°–59°.

Leucophrys patula, which is exclusively carnivorous, divides once in twenty-four hours at 43°–45°, twice at 46°–52°, three times at 54°–57°, four times at 59°–64°, and five times at 66°–68°; *Colpidium colpoda* twice at 54°–57°, three times at 59°–68°; *Coleps hirtus* once at 61°–64°; *Loxophyllum fasciola* twice at 59°–63°; *Spathidium hyalinum* once at 61°–63°, and twice at 63°–66°; an undetermined *Vorticella* once at 57°–61°.

Glaucoma scintillans, *Stylonychia pustulata*, *Colpidium colpoda*, and *Paramœcium bursaria*, kept in complete darkness for a month, multiplied exactly like those exposed to light.—*Comptes Rendus*, April 4, 1887, p. 1006.

On the Relations of the Groups of Arthropoda. By Prof. Carl Claus.

In our number for March 1887, when printing Prof. Lankester's "Last Words on Professor Claus," we stated that the discussion on the matters in dispute must cease. We have since received from Prof. Claus a copy of an article on the subject in question published by him in the 'Arbeiten aus dem Zoologischen Institut der Universität Wien' (Band vii. Heft 2), in which he gives an exposition of his own views, with a request that a translation of this part should appear in the 'Annals,' for comparison with the conclusions formulated by Prof. Lankester in the article above cited. The "essential points" upon which Prof. Claus insists are stated by him as follows:—

"1. The opinion, according to which the Scorpions, and consequently the Arachnoidea, are to be derived phylogenetically from the Gigantostraca, was independently supported by me, following Huxley, as much as eleven years ago.

"2. The distinction of the three Arthropod series—1. Crustacea, *s. str.*; 2. Gigantostraca, Arachnoidea; 3. Myriopoda-Insecta—is implicitly contained in the passages cited of my Text-book (1880).

"3. My views as to the relation of *Limulus* to the Arachnoidea are quite different from the conception which is supported by Ray Lankester in 1881 in his *Limulus*-article.

"4. The reference of the Mites to retrograde Arachnoidea, which is supported by the discovery of the rudimentary heart, is self-evident as a necessary consequence of the position laid down under § 1, and certainly does not date from Ray Lankester's expositions, but had been supported many years ago upon other grounds.

"5. The hypothesis of the 'adaptational shifting of the oral aperture,' invented by that author from the analogy of the shifting of the mouth in *Amphioxus*, and by which the interpretation of the præoral limbs of the Arthropoda, and consequently both pairs of antennæ in the Crustacea, is proved, is a perfectly untenable hypothesis.

"6. This hypothesis has nothing in common with the opinion, founded upon the conditions of innervation, that the second pair of antennæ of the Crustacea represents the foremost truncal members, while the first pair of antennæ, like the antennæ of Insects and Myriopoda, belongs to the præstomial part of the head."

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[FIFTH SERIES.]

No. 114. JUNE 1887.

LI.—*Description of a second Species of Rabbit-Bandicoot* (Peragale). By OLDFIELD THOMAS, Natural-History Museum.

AMONG a small collection of Mammals obtained by the Natural-History Museum from Mr. J. Beazley, of Adelaide, occurs a specimen clearly representing a new species of the interesting genus *Peragale*, of which the only hitherto described species was the well-known Rabbit-Bandicoot (*P. lagotis*) of Western and Southern Australia. The exact locality of the specimen has unfortunately not been recorded; but the other specimens in the collection belong either to North Australian species or to such as may have been obtained in the neighbourhood of Adelaide itself.

The type specimen, happily well preserved in spirit, is a male, young enough to have its milk premolar (m. pm.^{4}) still in position, but yet showing, despite its youth, such striking characters as to separate it at once from *P. lagotis*.

Peragale leucura, sp. n.

Much smaller than *P. lagotis*. Proportions, lengths of ears, feet, and tail, and quality of fur quite as in that species. General colour pale yellowish fawn; the hairs of the back and

crown slaty grey at their bases, those of the muzzle, chin, chest, belly, limbs, and tail pure white or yellowish white to their roots. Naked rhinarium small, not running back along the top of the muzzle, as in *P. lagotis*. Ears, as usual, enormously long, laid forward they reach beyond the muzzle; evenly thinly clothed with very fine short silvery hairs, which form a delicate fringe round their edges; their substance yellowish flesh-colour, except for their posterior half terminally, where it is slaty grey. Fore limbs pure white, thickly hairy everywhere, except along the underside of the fingers; thumb and fifth finger clawless, as usual; second and third fingers subequal, fourth reaching to the middle of the terminal phalanx of the third, fifth reaching just beyond, and thumb just to the level of, the base of the fourth; a small round naked pad at the base of each of the digits except the thumb, much more distinctly defined than in *P. lagotis*. Hind limbs also pure white, without any black hairs along the sole; the latter completely hairy, except on the compound terminal projection, on which there are two small but distinct pads; fifth toe reaching to the end of the first phalanx of the fourth; united second and third to the base of the fourth. Tail thin and slender, *wholly white-haired*, the hairs quite short on the sides and below, but above forming a beautiful prominent white crest, increasing in length to the tip, where the hairs are more than 30 millim. in length.

Skull, so far as can be judged from so young a specimen, with all the essential characters of that of *P. lagotis*, except that the bullæ are more evenly hemispherical in their shape and not so prominently bulbous postero-externally.

Teeth very much smaller than those of *P. lagotis* (see dimensions), and showing that *P. leucura*, when full-grown, cannot be more than two thirds the size of *P. lagotis*. Upper incisors quite similar in shape to those of that animal; canines much straighter and slenderer, their antero-posterior diameter at 3 millim. from their tip only 1·6 millim. as compared to 2·3 in an immature specimen of *P. lagotis* with unworn teeth. $Pm.^1$ and $pm.^3$ * shaped as in *P. lagotis*; milk premolar (m. $pm.^4$) much smaller than in that species, its transverse diameter equal to, instead of only about half, its longitudinal diameter. Molars differing strikingly from those of *P. lagotis*, and showing a distinct approximation to those of *Perameles*

* It has been shown elsewhere that the two anterior premolars of the Dasyuridæ, and therefore probably of the other Polyprotodont Marsupials, are homologous with the first and third of the placental premolars, and should therefore be called $pm.^1$ and $pm.^3$ (Proc. Roy. Soc. 1887).

proper by their short multicuspidate crowns and by the much earlier period at which they form roots, the roots of the two anterior molars being already formed and closed up in the type specimen, young as it is, while in *P. lagotis* the crowns are very long and the roots do not close up until quite late in life.

Lower teeth differing, tooth by tooth, from those of *P. lagotis* exactly as do those in the upper jaw.

Dimensions of the type, a young male in spirit:—

Head and body 142 millim.; tail 116; hind foot 55; ear (above crown) 63.

Skull: basal length 45; greatest breadth 22·5; nasals, length 18, greatest breadth 4·5; interorbital breadth 10; palate, length 27·7.

Teeth, as compared to those of an immature specimen of *P. lagotis*:—

	P. leucura.		*P. lagotis.*	
	Upper.	Lower.	Upper.	Lower.
Incisor series, length	5·4	3·9	8·4	5·8
Pm.[1], horizontal length	3·0	3·0	4·0	4·3
Pm.[3], " "	3·0	3·2	4·0	4·7
Milk pm.[4] " "	1·1	1·1	2·5	2·3
M.[1] and m.[2], combined lengths	7·0	7·1	9·0	9·3

The occurrence of this second species of the remarkable genus *Peragale* is a matter of considerable interest, especially as the new form is a very prominent and handsome animal, and one that it is surprising has not been discovered before. It is much to be hoped that the true home of this beautiful species will soon be found out, and that the publication of its description will result in more specimens becoming available for scientific examination.

Judging by the pale colour of its fur it is evident that *P. leucura* is more distinctly an inhabitant of sandy country than *P. lagotis*, such a coloration being a well-known characteristic of desert animals; and we may therefore expect that the home of this species will be found to be the vast sandy plains of the interior, and, considering the history of the collection, probably those of the central or northern parts of the colony of South Australia.

LII.—*Notes on the Palæozoic Bivalved Entomostraca.—No. XXIV. On some Silurian Genera and Species** (*continued*). By Prof. T. Rupert Jones, F.R.S., F.G.S.

[Plates XII. & XIII.†]

In this paper the specimens in Messrs. Vine's and Smith's Collections ‡ not yet treated of will be described.

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I. Thlipsura, Jones & Holl, 1869.

This Silurian genus of Ostracodes was defined in the Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 214.

* For No. XXIII. see Ann. & Mag. Nat. Hist. for March 1887, p. 177.

† These Plates have been drawn with the aid of a grant from the Royal Society for the illustration of Fossil Entomostraca. Mr. C. D. Sherborn has kindly helped me in cataloguing, comparing, sketching, and measuring the specimens.

‡ Ann. & Mag. Nat. Hist. April 1886, p. 343.

1. *Thlipsura corpulenta*, J. & H.

Thlipsura corpulenta, J. & H., Ann. & Mag. Nat. Hist. ser. 4, vol. iii. (1869), p. 214, pl. xv. figs. 1 *a*–1 *d*.

Proportions †:—Length 28. Height 18. Thickness 16.

The specimens originally described and figured in 1869 were from the base of the Woolhope beds and from the Wenlock Shale and Limestone, and their liability to variation was noticed. Mr. Vine's specimens are from the Wenlock Shales, rather abundant in the *lower*, and very abundant in the *upper* Shales. The individuals vary considerably in relative size, and the characteristic sulcus varies much in its depth. Mr. Vine refers to this species in the Q. J. G. S. vol. xxxviii. p. 48.

Sixty specimens:	Vine Coll. no. X., XVII.	Bed ‡ no. 46. Shales over Wenlock Limestone.
	XVIII.	Bed no. 25*. Tickwood Beds.
	LI.	Bed no. 25. Tickwood Beds.
	LV.	Bed no. 46.
	$LXV_{1,3}$.	Shales over Wenlock Limestone.
	$LXVI_{3,5}$.	Tickwood Beds.
	LXVII.	Bed no. 46.
	LXIX.	Bed no. 46.

Twenty-nine specimens:	Smith Coll. no. 1.	Malvern Tunnel, west end.
	2.	Malvern Tunnel, west end, red shale.
	3.	Dormington.
	5.	Railway-cutting, side of Severn, Ironbridge.
	8.	Railway-cutting near Much Wenlock.

2. *Thlipsura tuberosa*, J. & H.

Thlipsura tuberosa, J. & H., Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 215, pl. xv. figs. 2 *a–c*.

Proportions :—L. 23. H. 14 (including the lateral tubercles). Th. 11.

One specimen was in hand (from Wenlock Shale) when

† If these proportional numbers be divided by 20 the results will be the real measurements in millimetres and parts of a millimetre.

‡ For the list of strata examined, see Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. p. 344; and Proceed. Geol. Polytech. Soc. West Riding, Yorkshire, vol. ix. part 2, pp. 229–234.

the species was described in 1869; only a few more are now known. Referred to in Mr. Vine's list, Q. J. G. S. vol. xxxviii. p. 48.

One specimen:—Vine Coll. XVIII. Bed no. 25*. Tickwood Beds.

Three specimens:	Smith Coll.	no. 3.	Dormington.
		no. 8.	Railway-cutting near Much Wenlock.

3. *Thlipsura angulata*, sp. nov.
(Pl. XII. figs. 9 *a*, 9 *b*.)

Proportions:—L. 22. H. $13\frac{1}{2}$. Th. $12\frac{1}{4}$.

Carapace ovate and convex, marked on the posterior moiety by an oblique depression, furrowing the surface from the antero-dorsal region to the posterior margin. Below the end of the furrow the valve is slightly depressed longitudinally towards the middle, leaving a slight angular elevation of the surface pointing backwards. Edge view of carapace not suboblong as in *Thl. corpulenta*, but ovate with sharp posterior end.

One specimen:—Vine Coll. XVI. Bed no. 46. Shales over Wenlock Limestone.

4. *Thlipsura plicata*, sp. nov. et varr.
(Pl. XII. figs. 10–13.)

		Length.	Height.	Thickness.
Proportions:	Fig. 10:	$21\frac{1}{2}$	$12\frac{1}{2}$	
	Fig. 11:	22	11	
	Fig. 12:	22	13	
	Fig. 13:	22	13	10

The specimens under notice are subovate and convex, and some of them have much resemblance to *Thl. tuberosa*, J. & H., in their narrow-ovate outline, their subovate edge view, and the somewhat analogous style of the oblique folds and furrows on their posterior moiety; but there is an absence of the tubercle on the anterior half of the valve which characterizes *Thl. tuberosa*. In *Thl. plicata* (fig. 10) the front pit present in *Thl. tuberosa* is wanting, though in its varieties (figs. 11, 12, 13) this small crescent-shaped sulcus is vaguely represented by one or more variable roundish pits.

Fig. 10 shows two oblique hollows, one close to the postero-dorsal margin and another parallel with it, lower down, and much broader, a convex fold-like elevation dividing them.

Fig. 11 shows the larger sulcus lying as in fig. 10, but

more pyriform; and there is a small furrow below instead of above it, and directed towards a small pit in the middle of the anterior third of the valve.

Fig. 12 shows a higher subovate carapace, with one oblique sulcus, somewhat like that in fig. 9 *a*, but shorter and deeper; and there is a pinching-in of the ventral region, obscurely connected with a rather large obliquely oval pit anteriorly.

Figs. 11 and 12 might be grouped as var. *unipunctata.*

Fig. 13 has a large, oblique, pyriform sulcus across the posterior moiety, much like that in fig. 11, and the ventral region has a median oblique depression leading up into a rather large oval pit, immediately above which is another such pit, so that an oblique, convex, fold-like elevation of the shell divides the two pits from the posterior sulcus. This form may be separated as var. *bipunctata.*

All the known *Thlipsuræ* are evidently closely related among themselves as far as the evidence of the carapaces can show, the modifications of outline, contour, and surface-markings being relatively slight from stage to stage. The soft parts, however, of the animals being unknown, and probably important in their differences, we must give the more credit to the changes in the form of the valves, as often noticed in former papers on fossil Entomostraca.

Four specimens :	Vine Coll.	Fig. 10. XVI_3.	Bed no. 26. Shales over Wenlock Limestone.
		Fig. 11. XVI_8.	
		Fig. 12. XVI_4.	
		Fig. 13. XVI_5.	

5. *Thlipsura v-scripta*, J. & H.

Thlipsura v-scripta, J. & H., Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 214, pl. xv. figs. 3 *a–c*.

Proportions :—L. $16\frac{1}{2}$. H. $10\frac{1}{3}$. Th. 9.

The angular sulcus on the hinder half of the valve may be looked upon as an intensified form of the posterior depressions in *Thl. angulata* and *plicata*, and the anterior sulcus as corresponding with, but much more definite than, the pits in the varieties *unipunctata* and *bipunctata* of *Thl. plicata. Thl. v-scripta* was referred to by Mr. Vine in the Q. J. G. S. vol. xxxviii. p. 48, as *Thl. corpulenta*, var. *scripta.*

This species, in 1869, we found rare in the Wenlock Limestone; a few more have been met with by Messrs. G. R. Vine and J. Smith. It is extremely abundant in the Silurian Limestone of Scandinavia (Ann. & Mag. Nat. Hist.

March 1887, p. 194). Indeed it has been figured and described from that source, under the name of *Primitia minuta*, by Dr. A. Krause, in the Zeitschr. d. d. geol. Ges. vol. xxix. p. 38, pl. i. fig. 19.

Seven specimens :	Vine Coll.	no. LXV_2.	Shales over Wenlock Limestone.
		$\text{LXVI}_{5,6}$.	Tickwood Beds.
Seven specimens :	Smith Coll.	no. 4.	Railway-cutting, side of Severn, Ironbridge.
		7.	Woolhope.

II. Octonaria, gen. nov.

In this peculiar form of carapace the valves are subovate in outline, thick, and flattened, with variously moulded surface. The ventral margin is usually straighter than the dorsal. The superficial plateau is more or less regularly bordered by a curved ridge, within which there are one or more hollows and different elevations; the latter are usually connected with the ridge, but sometimes isolated. The inclination shown by the ridge in many cases to turn in on itself in the ventral region, and thus more or less closely imitate a *figure-of-eight*, is the foundation for the generic name. In all cases the edge view of the carapace is much like that of *Thlipsura corpulenta*, that is, suboblong with subacute ends; the valves being nearly flat on the surface and sloping down to the edges all round, like a high pie in a deep dish, and like some metal cover-dishes used for entrées &c.

1. *Octonaria octoformis*, sp. nov.
(Pl. XII. figs. 2 *a*, *b*; and varieties figs. 3 *a*–8 *b*.)

Proportions:—L. 27. H. 15. Th. 13.

In this form the surface-ridge is slightly bent inwards on the dorsal region, and turned in with a loop ventrally, thus meeting mesially and forming a *figure-of-eight*. This, for convenience, is taken as the type.

One specimen:—Vine Coll. no. XVIII_2. Bed no. 25*. Tickwood Beds.

1*. Var. *intorta*, nov. (Pl. XII. figs. 3 *a*, 3 *b*.)

Proportions:—L. 23. H. 13. Th. 11½.

The ridge is perfect dorsally in this case, but divides below, and turns in its two ends, one of which (anterior) is thickened.

One specimen:—Smith Coll. no. 80. Woolhope.

1**. Var. *simplex*, nov. (Pl. XII. figs. 4 *a*, 4 *b*.)

Proportions:—L. 21. H. $12\frac{1}{4}$. Th. 9.

The ridge of the plateau in this neat and rather small carapace is perfect all round the oval bounding the median hollow, but ventrally it has a triangular promontory pointing inwards, and analogous to the ventral modifications of figs. 2 and 3.

Two specimens:—Vine Coll. no. LXVI$_{5, 13}$. Tickwood Beds.

1***. Var. *informis*, nov. (Pl. XII. figs. 5 *a*, 5 *b*.)

Proportions:—L. 20. H. $11\frac{1}{2}$. Th. $11\frac{1}{2}$.

Oval in outline and subquadrate in edge view. The oval ridge ventrally is continued inwards by a thickening, which is at first curved and then stretched across to the dorsal part of the ridge, thus dividing the valve-surface into two irregular hollows, of which one is simply a curved sulcus, and the other is like a long and thick inverted comma.

One specimen:—Vine Coll. no. LXVI$_5$. Tickwood Beds.

1****. Var. *bipartita*, nov. (Pl. XII. figs. 6 *a*, 6 *b*.)

Proportions:—L. 29. H. 17. Th. $13\frac{1}{2}$.

Here within the ridge is a short cross ridge nearly in the middle, connecting the two sides and making a pattern like that of a strong chain-cable. In some individuals (LIII.) the valves are shorter and the two hollows rounder and nearer together, thus becoming more truly like a figure-of-eight.

Nine specimens: Vine Coll. no. LII., LIII., LVII. Bed no. 46. Shale over Wenlock Limestone.
LXV$_8$. Shale over Wenlock Limestone.

1*****. Var. *persona*, nov. (Pl. XII. figs. 7 *a*, 7 *b*.)

Proportions:—L. $22\frac{1}{4}$. H. 16. Th. 12.

Carapace relatively short and high, the dorsal edge being nearly semicircular, and the ventral almost straight. The plateau is divided by a cross ridge, and a semicircular hollow remains on one side (posterior); while on the other there are three smaller hollows due to subdivisions by a small furcate ridge. Looked at in one direction (front end upwards) it shows a mask (*persona*), two round hollows representing the eyes, beneath which are the signs of nose and mouth.

One specimen:—Vine Coll. no. LIII. Bed no. 46.

1******. Var. *monticulata*, nov. (Pl. XII. figs. 8 *a*, 8 *b*.)

Proportions :—L. 25½. H. 14. Th. 12.

Here we have the encircling oval ridge perfect and simple, and an isolated tubercle within and near its antero-ventral portion, just where the thickened inturned end is present in fig. 3 *a*. It is homologous also probably with the local thickenings in the other varieties.

Two specimens : Vine Coll. no. XVI$_{6}$. Bed no. 46. Shale over Wenlock Limestone.
LXV$_{3}$. Shale over Wenlock Limestone.

In LXV$_{2}$ and LXVI$_{12,\ 14}$ there are five obscure specimens of *Octonaria.*

2. *Octonaria undosa*, sp. nov. (Pl. XII. figs. 1 *a*, 1 *b*.)

Proportions :—L. 35. H. 15½. Th. 12.

This relatively long valve has nearly parallel dorsal and ventral edges and obliquely rounded unequal ends. The sides slope strongly to the margin all round. The anterior extremity is obliquely produced and more compressed than the other. The middle of the valve is raised into an obscure and imperfect figure-of-eight, the loops being open along the dorsal region (as fig. 4 might be, if the ridge were dorsally imperfect) ; or it may be said to be raised nearly flat, with two shallow bay-like dorsal impressions, and a middle ventral inlet, altogether giving a rough figure-of-three if looked at with the anterior end upwards. The edge view of the two valves closed would approximate to that of other *Octonariæ*, but with sharper ends.

One specimen :—Smith Coll. no. 70. Lincoln Hill, Ironbridge.

3. *Octonaria? paradoxa*, sp. nov. (Pl. XIII. fig. 12.)

Proportions :—L. 20. H. 10.

This peculiar form may probably belong to the Octonarian group, though differing very much from the species above described. The valve, however, is raised into a thick, smooth, figure-of-three ridge, somewhat like that in Pl. XII. fig. 1 ; and the isolated tubercle has an analogue in fig. 8. The absence of a broad sloping margin is observable. The dorsal

border is straight in this instance, as in Pl. XII. fig. 1, and not curved as in figs. 2–8.

Three specimens : { Vine Coll. XXXVII. (fig. 12). Bed no. 37, Buildwas Beds.
LXIV$_{14}$. Buildwas Beds. }

4. *Octonaria* ?, sp.

Proportions :—L. 21. H. 12½. Th. 8.

There was also a unique and peculiar specimen from the Tickwood Beds, but unfortunately lost, which presented an ovate convex valve, having a large, well-defined, oval, central depression, with a small tubercle rising in its middle. The broad raised part of the valve surrounding the hollow may be equivalent to the narrower ridge in *Octonaria octoformis* and its varieties, and the central pimple might find its analogue in the isolated tubercle in figs. 8 *a*, *b*. The valve in edge view was flattened along the middle and steeply sloping at the ends, as in *Octonariæ*. Seen on the inside the valve showed marks of a hinge-line on one margin free of matrix.

In his paper on the Cambrian and Silurian fossils of West Gothland ('Kongl. Svenska Vetenskaps-Akad. Handl.' vol. viii., 1869) Dr. J. G. O. Linnarsson described and figured two small Ostracodes which apparently have some relationship with the form described above as a doubtful member of the Octonarian group. Thus at p. 85, pl. ii. fig. 68, one of the illustrations of his *Beyrichia costata* (from the *Beyrichia*-limestone) has an isolated tubercle, rather forward (?) on the valve, within a circular ridge and furrow. His figure of *Primitia strangulata* (fig. 69, from the same limestone) appears to be not Salter's species, but a simple convex suboblong valve with a sunken tubercle on it, very much like the above-mentioned dubious Octonarian form.

To the same category we may perhaps refer Dr. R. Richter's figs. 13 and 14 in the pl. xix. illustrating his paper on the schistose rocks of Thuringia (Zeitschr. d. d. geol. Ges. vol. xv., 1863). These two figures show small, suboblong, obscure valves, each having a central tubercle; and, with others, Richter referred them to his *Beyrichia subcylindrica*, from the Nereites-bed, p. 671. See also Geol. Mag. 1881, p. 342.

III. Bollia, Jones & Holl, 1886.

Bollia, Jones & Holl, Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. p. 360.

This genus, related to *Beyrichia*, but distinguished by having one median sulcus and two lobes, was established for *B. bicol-*

lina and *B. uniflexa* of Mr. Vine's Collection, and *B. colwallensis* was also referred to it (*loc. cit.* p. 362). A peculiar form in Mr. Smith's Collection, evidently related to the last, is now to be noticed.

1. *Bollia auricularis*, sp. nov.
(Pl. XIII. figs. 10 *a*, 10 *b*, 10 *c*.)

Proportions:—L. $22\frac{1}{2}$. H. 12. Th. 9 (and with the flanges $11\frac{1}{2}$).

The valves have an irregular oblong outline, straight on the dorsal and sinuous on the ventral edge, if looked at with the flange in sight, but neatly elliptical-convex as seen free of the flange, which projects outward and downward along the greater part of the ventral region, but not so equal and continuous as in *Beyrichia Maccoyiana* (Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. p. 357, pl. xii. figs. 11 *a* and 11 *c*). The valves are bordered by a thickened marginal rim on the free edges. The centre has a deep bay-like sulcus separating the surface into two unequal subtriangular lobes, united by a narrow isthmus on the ventral region.

In some aspects this specimen has a distant resemblance to the outline of the human ear, hence the name.

One specimen:—Smith Coll. no. 26. Railway-cutting, side of Severn, Ironbridge.

2. *Bollia interrupta*, sp. nov. (Pl. XII. fig. 14.)

Proportions:—L. 29. H. 21.

This form approaches *Bollia uniflexa*, J. & H. (Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. p. 361, pl. xii. fig. 17), but the posterior lobe is interrupted by a shallow oblique furrow just where it is largest in *B. uniflexa*. The area, however, of the perfect lobe is approximately indicated by a low swelling outside and uniting the two contracted lobules that lie within the region of the typical lobe.

One specimen:—Vine Coll. Bed no. 37. Buildwas Beds.

IV. Primitia, Jones & Holl, 1865.

Most of the *Primitiæ* in Messrs. Vine's and Smith's Collections have been described or noticed in the Ann. & Mag. Nat. Hist. for May 1886, pp. 409–413, and for March 1887, p. 193. There remains another species, which is related to the simple *P. umbilicata* type (Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. p. 420, pl. xiii. fig. 2).

1. *Primitia obliquipunctata*, sp. nov.
(Pl. XIII. figs. 1 *a*, 1 *b*, 1 *c*.)

Proportions:—L. 14½. H. 9. Th. 7½ (including the processes 10).

These rather small carapaces have suboblong valves, straight on the back, boldly curved in front and below, and defined by an elliptical slope on the postero-ventral margin. Much thicker (more convex) behind than in front; and this feature is enhanced by the presence of a blunt spine on the postero-ventral region, pointing backwards. There is a pit on the middle of the valves, usually rather above the median line. The surface of the valves is ornamented with a delicate punctation, in slightly oblique lines, from the antero-ventral region upwards to the dorsal and posterior margins. The little pits are ruled, as it were, by parallel oblique raised lines or slight ridges (see fig. 1 *c*). There is a slight ventral rim. Edge view of carapace sagittate, the postero-ventral processes forming the barbs.

Four specimens:—Smith Coll. no. 68. Woolhope.

V. Moorea, J. & K., 1867.

This genus and one species were described by Jones and Holl in the Ann. & Mag. Nat. Hist. ser. 4, vol. iii. (1869), p. 225, and it is the only genus to which the specimen fig. 11 on Pl. XIII. appears to be referable, though differing considerably in some respects as well from *M. silurica*, *loc. cit.* pl. xv. figs. 8 *a*, 8 *b*, as from *M. obesa* and *M. tenuis* (both from Carboniferous rocks), *op. cit.* ser. 5, vol. xviii. p. 261, pl. viii. figs. 20 and 21. The raised feature on the new specimen under notice is a median ridge forking at the posterior region, and continuing along the posterior margins, so as to give to the ventral edge of the carapace an appearance recognizable also in the other species above mentioned.

1. *Moorea Smithii*, sp. nov. (Pl. XIII. figs. 11 *a*, 11 *b*.)

Proportions:—L. 17. H. 9. Th. 8.

A neat, ovate-oblong, smooth carapace; the ends almost equally rounded, but the anterior rather more elliptical and more compressed than the other, which is thick and truncate. A smooth, low, median ridge on each valve divides on the posterior third into two branches. These form the corners at the hinder end of the valve, and one continues round on the

postero-ventral region. In the closed valves the ventral aspect presents a bluntly tapering anterior extremity and a truncate hinder end, which is modified by the triangular union of the ridges continued downwards and forwards from the face of the valve.

Instead of the superficial ridge passing round the periphery of the valve, as in the other species alluded to above, it seems here to extend with an imperfect curve only towards the centre and then to die out in a single median extension.

Named after its discoverer, Mr. John Smith, of Kilwinning, Ayrshire.

One specimen :—Smith Coll. no. 57. Railway-cutting, side of Severn, Ironbridge.

VI. Xestoleberis, G. O. Sars, 1865.

1. *Xestoleberis corbuloides* (J. & H.).

Cythere corbuloides, Jones & Holl, Ann. & Mag. Nat. Hist. ser. 4, vol. iii. (1869), p. 211, pl. xv. figs. 4 *a*–5 *b*.

The sizes vary with age and in individuals; in a full-grown specimen the proportions are as follows :—

Proportions :—L. 21. H. 13. Th. 15½.

This seems to be referable to *Xestoleberis* because it much resembles some members of that genus in certain features and in general habit. See also Ann. & Mag. Nat. Hist. October 1886, p. 264, for a note on the Carboniferous *X.*? *subcorbuloides*, J. & K.

Six specimens :	Vine Coll. no.	x.	Bed no. 46. Shales over Wenlock Limestone.
		xi.	Bed no. 43. Coalbrook Dale Beds.

Mr. Vine has also met with this species in Beds no. 25 and 25*. Tickwood Beds.

Eighteen specimens :	Smith Coll. no.	44.	Sedgeley.
		45.	Railway-cutting, side of Severn, Ironbridge.

VII. Æchmina, J. & H., 1869.

Æchmina, Jones & Holl, 1869, Ann. & Mag. Nat. Hist. ser. 4, vol. iii. p. 217.

Rare specimens only of two species of this genus were known in 1869 from the Wenlock Limestone near West Mal-

vern. Messrs. Vine and Smith have found many individuals, and added to the number of known species, though their collections do not appear to contain an example of Jones and Holl's second species, namely *Æchmina clavulus.* It may be added that some of the present specimens show a delicate serration of the free margins (see figs. 5 *a*, 5 *c*, and 9, Pl. XIII.). This ornament is more perfect and delicate in some Scandinavian specimens, exquisite drawings of which have been sent by Dr. Lindström.

1. *Æchmina cuspidata*, J. & H.
(Pl. XIII. figs. 2, 3 *a*, 3 *b*, 4 *a*, 4 *b*, 4 *c*, and 9.)

Æchmina cuspidata, J. & H., *op. cit.* p. 218, woodcut, fig. 2, and pl. xiv. fig. 8.

Proportions :—

	Length.	Height.	Thickness at the root of the spikes.	Length of the spike.	Width between the ends of the spikes.
Fig. 3 :	$28\frac{1}{4}$	15	10	21 (not quite perfect at the tip).	32
Fig. 4 :	$22\frac{1}{2}$	12	8	23	$34\frac{1}{2}$

Only a fragment of this delicate form was met with and described in 1869. The woodcut referred to gives the form of its valve, and the present figs. 2, 3 *a*, and 9 correspond with it. The position of the stout, sharp, hollow spike is also the same. The specimens before us show beautifully the exact proportions, direction, and length of these remarkable horn-like processes of the valves.

There are some slight differences between fig. 3 and fig. 4, as to both the height of the valve and the angle of direction and of divergence in the processes. In fig. 4 the valve is not only smaller, but it is relatively more contracted anteriorly, the antero-ventral margin being less convex than in fig. 3 *a*, and the posterior margin projects more in the middle than above. The spike also is not so upright as in figs. 2 and 3 *a*, but leans more forward; and it had a rather more open angle of divergence from its fellow when the valves were closed, as may be seen on a comparison of fig. 4 *b* with fig. 3 *b*. These differences, however, may be sexual or the peculiarities of individual growth. Angle of divergence in fig. 3 *b* (1) at the top of the valve 45°, (2) taken from the middle front of the valves 58°; in fig. *b*, (1) 40°, (2) 50°.

The end views may be roughly compared with a three-rayed star, in which the lower portion is somewhat shortened and very much thickened.

Specimens:		
cuspidata, 8	Vine Coll.:	
bovina, 3	Figs. 5 & 9: no. XIX.	Beds no. 25 & 25*.
depressicornis, 1	Fig. 7: XX.	Tickwood
brevicornis, 1	Fig. 8: XXI.	Beds.
obscura, 2		

Mr. John Young and Mr. Vine met with fragments of spines and valves in Bed no. 46, shales over Wenlock Limestone.

Specimens:		
cuspidata, 10	Smith Coll.	Figs. 2, 3, & 4, no. 41. Woolhope.
bovina, 2		No. 46. Railway-cutting, Coalbrook Dale.
		Fig. 6, no. 47. Railway-cutting, Severn side, Ironbridge.

2. *Æchmina bovina*, sp. nov.
(Pl. XIII. figs. 5 *a*, 5 *b*, 5 *c*, 6 *a*, 6 *b*, 6 *c*.)

Proportions:—

	Length.	Height.	Thickness at root of the spike.	Length of spike.	Width between the tips.
Fig. 5:	$18\frac{1}{4}$	11	$7\frac{1}{2}$	10	$16\frac{1}{2}$
Fig. 6:	$13\frac{1}{2}$	9	$7\frac{1}{2}$	10	$15\frac{1}{2}$

The carapace-valves have a straight dorsal and nearly semicircular ventral border. The hollow spike or horn is thicker than in *Æch. cuspidata*, its base taking up a larger portion of the valve's surface; it is also shorter, and has a slight curve upwards and inwards. The angle of divergence of the spikes in the closed valves is, (1) from the top of the valves to the point of horn 45°, (2) from the middle of the front of the valves to the point of the horn 55° to 60°. In some specimens there is a tendency to have the base of the spike somewhat contracted or depressed before it rises above the surface. Seen endwise the carapace, with its valves united (figs. 5 *b*, 6 *b*), reminds us of the aspect presented by the face and front of some of the Bovidæ, whilst figs. 3 *b* and 4 *b* of *Æch. cuspidata* have more analogy to the long straight horns of some antelopes, such as the *Oryx* and *Anoa*.

Æch. bovina approaches *Æch. clavulus*, J. & H. (Ann. & Mag. Nat. Hist., *l. c.*, woodcut, fig. 2), in some respects, but the base of its hollow spike takes up much less space on the valve. In *Æch. clavulus*, indeed, the base of the spike is conterminous with the margins of the valve, whereas in the other it carries out with it only about a third of the surface or a little more.

3. *Æchmina depressicornis*, sp. nov. (Pl. XIII. figs. 7 *a*, 7 *b*, 7 *c*.)

Proportions :—

Length.	Height.	Thickness at root of spikes.	Length of spike.	Width between the tips.
$11\frac{3}{4}$	$5\frac{1}{2}$	4	5	11

The carapace in this species is small and relatively longer, narrower, and thinner than the foregoing, the antero-ventral margin having less convexity even than we see in fig. 4 *a*, and the valves being rather less convex. The characteristic spikes or horns are placed as usual, but protrude almost horizontally (fig. 7 *b*), having a relatively lower angle of divergence, namely (1) from the top of the valves 10°, (2) from the middle of the front 30°.

The end view (fig. 7 *b*), though still reminding us of bovine horns, cannot be safely matched with those of any special animal; it is almost like a three-rayed star.

4. *Æchmina brevicornis*, sp. nov. (Pl. XIII. figs. 8 *a*, 8 *b*.)

Proportions :—

Length.	Height.	Thickness (including the root of the spikes).	Length of spike.	Width between the tips.
25	16	11	3	6

This rather rare form has proportionally a greater height of valve than *Æch. cuspidata*, being much shorter, and is actually higher than *Æch. bovina*, which it most closely resembles in the nearly semicircular outline of the ventral margin. The hollow process on the dorsal region is very short and feebly developed, the surface of the valve not being carried outwards so much as in the other species; and the carapace is therefore relatively thinner than the others.

The end view of this short-horned species is somewhat sagittate, with the barbed extremity upwards; or it might be described as a narrow acute-oval, with a triangular piece removed from the top.

VIII. Appendix.

The number of Specimens.

With the view of indicating approximately the numerical value of each species of the Silurian Ostracoda as described in

these memoirs on the Silurian species in Messrs. Vine's and Smith's collections (see Ann. & Mag. Nat. Hist. for April and May 1886, and March 1887), the number of the specimens of those species described or redescribed in 1886 are here given, together with the emendations required as to their special strata. Thus:—

Errata.

In the "Notes on the Palæozoic Bivalved Entomostraca, No. XX.," Ann. & Mag. Nat. Hist. April 1886:—

At page 353, *add* for var. *intermedia*: LIV_{12} (lost). Bed no. 37. Buildwas Beds.
355, *for* XLIV_{11} *read* $\text{LXIV}_{10,\,11}$. Buildwas Beds.
358, *add* for *Maccoyiana*: XLVI. Bed no. 25. Tickwood Beds.
361, *delete* LXII under *bicollina*.
362, *add* for *uniflexa*: LXII. Bed no. 22. Buildwas Beds.

In the "Notes, &c., No. XXI.," May 1886:—

At page 409, under *humilis*, *delete* LXIII. Bed no. 25. And *for* LXIV *read* LIV. Bed no. 37.
410, *add* for *valida*: LXIII. Bed no. 25. And *delete* LXV_{12}. Shales over the Wenlock Limestone.
410, under *tersa*, *read* no. 77 Dudley, *instead of* no. 78 Dudley.
413, under *seminulum*, *delete* no. 26, railway-cutting, side of Severn, Ironbridge (worn).

The number of the Specimens.

Genera and Species.	Number of the specimens in the collections. Vine.	Smith.
Beyrichia tuberculata (*Klœden*) (foreign).		
—— ——, var. gibbosa, *Reuter*	..	1
—— Klœdeni, *M'Coy* (varieties, as follows):—		
—— ——, var. granulata, *Jones*	10	7
—— ——, var. nuda, *Jones*	1	1
—— ——, var. antiquata, *Jones* (Jones's collection).		
—— ——, var. intermedia, *Jones* } —— ——, subvar. subspissa, *Jones & Holl* }	4	3
—— ——, var. subtorosa, *Jones*	2	33
—— ——, var. torosa, *Jones*	..	1
—— ——, var. tuberculata, *Salter*	36	21
—— ——, subvar. clausa, *J. & H.*	4	
—— ——, var. scotica, *J. & H.* (Mr. Grey's collection).		
—— concinna, *J. & H.*	..	1
—— Maccoyiana, *Jones*	8	18
—— Jonesii, *Boll* (Dr. Holl's collection).		
—— admixta, *J. & H.*	..	2

Genera and Species.	Number of the specimens in the collections. Vine.	Smith.
Beyrichia lacunata, *J. & H.*	2	5
Bollia bicollina, *J. & H.*	9	1
—— uniflexa, *J. & H.*	3	
Klœdenia intermedia, *J. & H.* (Jones's collection).		
—— ——, var. marginata, *J. & H.*	1	
Strepula concentrica, *J. & H.*	..	3
—— irregularis, *J. & H.*	3	7
—— beyrichioides, *J. & H.*	2	2
Bollia Vinei, *J. & H.*	2	1
—— ——, var. mitis, *J. & H.*	1	
Placentula excavata, *J. & H.*	5	18
Primitia lenticularis, *J. & H.*	6	20
—— Rœmeriana, *J. & H.*	5	
—— fabulina, *J. & H.*	2	9
—— variolata, *J. & H.*	2	7
—— paucipunctata, *J. & H.*	29	
—— humilis, *J. & H.*	10	2
—— valida, *J. & H.*	15	6
—— ——, var. breviata, *J. & H.*	9	
—— ——, var. angustata, *J. & H.*	5	
—— tersa, *J. & H.*	..	5
—— umbilicata, *J. & H.*	1	17
—— cristata, *J. & H.*	8	
—— ornata, *J. & H.*	4	2
—— cornuta, *J. & H.*	1	
—— æqualis, *J. & H.*	..	4
—— diversa, *J. & H.*	11	
—— seminulum, *Jones*	..	20
—— furcata, *J. & H.*	..	1

The numbers of specimens of the species described in 1887 can be seen in the memoirs themselves.

IX. EXPLANATION OF THE PLATES.

Plate XII.

[All the figures are magnified 20 diameters.]

Fig. 1. *Octonaria undosa,* sp. nov. *a,* right valve; *b,* edge view.
Fig. 2. *Octonaria octoformis,* sp. nov. *a,* left valve; *b,* edge view of carapace.
Fig. 3. *Octonaria octoformis,* var. *intorta,* nov. *a,* right valve; *b,* edge view of carapace.
Fig. 4. *Octonaria octoformis,* var. *simplex,* nov. *a,* left valve; *b,* edge view of carapace.
Fig. 5. *Octonaria octoformis,* var. *informis,* nov. *a,* right valve; *b,* edge view of carapace.
Fig. 6. *Octonaria octoformis,* var. *bipartita,* nov. *a,* right valve; *b,* edge view of carapace.

Fig. 7. *Octonaria octoformis*, var. *persona*, nov. *a*, right valve; *b*, edge view of carapace.
Fig. 8. *Octonaria octoformis*, var. *monticulata*, nov. *a*, left valve; *b*, edge view of carapace.
Fig. 9. *Thlipsura angulata*, sp. nov. *a*, right valve shown; *b*, edge view of carapace.
Fig. 10. *Thlipsura plicata*, sp. nov. Carapace, right valve shown.
Figs. 11, 12. *Thlipsura plicata*, var. *unipunctata*, nov. Left valve.
Fig. 13. *Thlipsura plicata*, var. *bipunctata*, nov. Carapace, right valve seen.
Fig. 14. *Bollia interrupta*, sp. nov. Right valve.

Plate XIII.

[All the figures are magnified 20 diameters except figs. 1 *c* and 5 *c*, which are magnified 70 diameters.]

Fig. 1. *Primitia obliquipunctata*, sp. nov. *a*, carapace, right valve seen; *b*, dorsal view; *c*, portion of surface enlarged (× 70).
Fig. 2. *Æchmina cuspidata*, J. & H. Inside of right valve.
Fig. 3. The same. *a*, right valve; *b*, end view.
Fig. 4. The same. *a*, left valve; *b*, end view; *c*, seen from above.
Fig. 5. *Æchmina bovina*, sp. nov. *a*, right valve; *b*, end view; *c*, portion of the edge enlarged (× 70).
Fig. 6. The same. *a*, left valve; *b*, end view; *c*, seen from above.
Fig. 7. *Æchmina depressicornis*, sp. nov. *a*, carapace, right valve seen; *b*, end view; *c*, seen from above.
Fig. 8. *Æchmina brevicornis*, sp. nov. *a*, right valve; *b*, end view.
Fig. 9. *Æchmina cuspidata*, J. & H. Fragment of a large right valve.
Fig. 10. *Bollia auricularis*, sp. nov. *a*, carapace, right valve upwards; *b*, ventral aspect; *c*, end view.
Fig. 11. *Moorea Smithii*, sp. nov. *a*, carapace, showing left valve; *b*, ventral aspect.
Fig. 12. *Octonaria? paradoxa*, sp. nov. Left valve.

LIII.—*Notes on some Land-Shells from New Guinea and the Solomon Islands, with Descriptions of new Species.* By Edgar A. Smith.

[Plate XV.]

The specimens here described form part of very valuable collections of shells which, from time to time, have been liberally presented to the British Museum by Mr. John Brazier of Sydney, to whom special thanks are due, as in several instances the specimens are unique and unrepresented in his own collection.

Nanina Hunsteini. (Pl. XV. fig. 6.)

Testa anguste perforata, tenuis, globoso-depressa, pallide luteo-

fuscescens vel purpureo-fuscescens, zona lata saturate fusca paulo supra peripheriam cincta, regulariter et confertim spiraliter striata, lineisque incrementi prope suturam subplicosis sculpta; anfractus 5, celeriter accrescentes, convexiusculi, suturam infra impresse submarginati et nigrescentes; ultimus magnus, paulo inflatus; apertura parum obliqua; peristoma tenue, margine columellari superne breviter expanso, umbilicum angustum partim obtegente.

Diam. max. 40 millim., min. 33, alt. 25.

Hab. Foot of the Astrolabe and Owen Stanley Ranges.

This species is peculiar on account of the regularity of the close spiral striation which covers the entire surface both below and above, with the exception of the few topmost whorls. The brown band which encircles the body-whorl falls a little above the middle, and, passing spirally upward, produces a dark margination to the whorls.

Nanina fraudulenta.

Testa globoso-depressa, anguste perforata, purpureo-fusca, epidermide tenui flavo-olivacea induta, nitida, lineis incrementi striata; anfractus 6, convexiusculi, ad suturam anguste marginati, ultimus rotundatus; apertura parum obliqua; peristoma tenue, prope umbilicum paulo incrassatum, album et reflexum.

Diam. max. 42 milim., min. 35, alt. 24.

Hab. Foot of Astrolabe Mountains, New Guinea.

This species, unless closely examined, might easily be confounded with *N. Hunsteini.* The form and size are almost similar, but the sculpture is different. This species has no trace of the regular fine spiral striæ which cover the entire surface of *N. Hunsteini.* It also differs from that species in having the spire a trifle more depressed, the body-whorl less inflated, and in not having the distinct brown band above the middle.

Nanina Cairni. (Pl. XV. fig. 5.)

Testa perforata, supra pallide fuscescens, infra albida, nitida, lineis incrementi minutis striata; anfractus 5, paulo convexiusculi, regulariter accrescentes, supra suturam leviter submarginati vel depressi, ultimus ad peripheriam subacute angulatus, infra angulum fuscescens, convexus, in medio albidus, minute concentrice undulatim striatus; apertura obliqua; peristoma tenue, margine columellari vix incrassato, superne supra umbilicum breviter reflexo.

Diam. max. 36 millim., min. 31, alt. 20.

Hab. Foot of the Astrolabe and Owen Stanley Mountains, British New Guinea.

The brown colour beneath the central angulation is a trifle darker than the tint of the upper surface. This has the appearance of being marked with obliquely-curved lines of growth, but under the lens it is seen to be sculptured with very minute wrinkly striæ in the same direction. The lower surface, which is more glossy, is destitute of this wrinkly sculpture, and has instead very fine close-set hair-like concentric undulating striæ which are invisible to the naked eye.

Nanina exilis, juv. (Pl. XV. fig. 13.)

Testa depressa, acute carinata, perforata, superne griseo-cornea, ininferne pallidior; anfractus 6, convexiusculi, supra suturam depresse marginati, striis incrementi sculpti; ultimus compresse et acute carinatus, inferne nitidus; apertura obliqua, subsecuriformis; peristoma tenue, margine columellari superne leviter reflexo.

Diam. max. 27 millim., min. 24, alt. 13½.

Hab. British New Guinea.

The sculpture of the upper surface of this species is almost precisely the same as that of *N. Cairni*. It is, however, a more sharply carinate shell, and has more numerous and narrower whorls. It is more acutely carinate than the type of *N. exilis*, Müller, lacks the brown band below the keel, and is a trifle more finely striated.

Helix (*Sphærospira*) *Rehsei*, Martens. (Pl. XV. fig. 14.)

Hab. Dinner Island, New Guinea (*Brazier*).

This species I described as *H. Gerrardi* * a month or two after the publication of Martens' diagnosis †. I then had only a single specimen under examination. Three additional examples, two of which were sent by Mr. Brazier, have since been added to the Museum collection. These show that the species varies considerably with regard to the umbilicus, which, as in the type, may be rather broad, or it may be gradually closed up by the overspreading reflexed columellar margin of the peristome, leaving only a small perforation. The indications on the body-whorl of a few shallow transverse indistinct sulci observable in the shell I originally described are less apparent (but still traceable) in the other specimens now at hand. The spire varies in height, and seems to be usually rather less elevated than in the specimen described in the 'Annals.' The granulation of the spire is also variable, being more strongly developed and extending much further down in some specimens than in others.

* Ann. & Mag. Nat. Hist. 1883, vol. xi. p. 192.
† Jahrb. deutsch. malak. Gesellsch. 1883, p. 83.

Helix (*Acavus*) *coraliolabris*. (Pl. XV. fig. 4.)

Testa elevate conica, imperforata, alba, labris intus purpureo-fuscis ad marginem saturate rufis instructa; anfractus $5\frac{1}{2}$, convexiusculi, oblique rugose et confertim striati, incrementique lineis flexuosis sculpti, ultimus in medio obtuse angulatus, inferne vix convexus, antice breviter descendens, pone medium labri leviter complanatus; apertura oblique irregulariter subquadrangularis, intus alba; peristoma paulo incrassatum et expansum, breviter reflexum, margine exteriore paulo supra medium obtuse angulato; columella late dilatata appressa, complanata, margine aperturam versus lilacea, superne callo nigro-fusco labro juncta.

Diam. max. 32 millim., min. 25, alt. 34.

Hab. Russell Island, New Guinea.

This species is so well defined by the remarkable contrast of the colour of the peristome with the white tint of the rest of the shell that it will readily be recognized. The edge of the aperture is thickened and bright coral-red, and this, both within and without, is rather deeply bordered, especially within, with purple-brown.

Helix (*Acavus*) *brumeriensis*, Forbes.

This species was originally described from a unique specimen (now in the British Museum) collected by Macgillivray at Brumer Island. The figures both in the 'Voyage of the Rattlesnake' and in Reeve's 'Conchologia Iconica' show it to be a small specimen in comparison with others now received from Mr. Brazier, which were collected on trees and bushes at Millport Harbour, near Amazon Bay, British New Guinea. The largest of these has a greatest diameter of 38 millim., and is 33 in height, whilst the type is only 28 in width and 24 high.

All of Mr. Brazier's specimens are also more conically elevated, have a more broadly dilated black columellar margin to the peristome, and the callus connecting the extremities is also more developed and jet-black. Several of them show indications over the entire surface of a peculiar cross-hatching of short lines of a pale dirty yellowish tint. The aperture in some specimens is tinted with very pale rose, in others it is white.

Another series of three specimens from "an island east of New Guinea" illustrates three different stages of growth. The youngest example, consisting of four whorls, is almost entirely of a light corneous tint, except towards the lip, where it becomes more opake white; it is also very thin and narrowly umbilicated. The oldest and mature specimen is

peculiar in having no black callus connecting the columella and extremity of the outer lip.

Helix (*Acavus*) *latiaxis*, Smith. (Pl. XV. fig. 7.)

A single specimen from the foot of the Owen Stanley Mountains, British New Guinea, differs from the type * in having the last whorl very much more sharply keeled at the periphery, the aperture consequently also being more pointed in front. The epidermis upon the body-whorl is disposed in ten spiral zones instead of six, five above and five below the carina. Being a younger shell, the interior has not been coated over with the bluish-white callus as in the adult type, and the external banding is, on account of the comparative thinness of the shell, obscurely visible.

Messrs. Brazier † and Tapparone Canefri ‡ consider this species the same as *H. zeno* of Brazier, described in the year 1876. This can scarcely be correct, as certain terms of the description are not applicable to *H. latiaxis*, which cannot be described as "*globosely turbinated*," nor "*thin*," nor "*flesh-colour*;" and the spiral bands do not "*in front all run into one.*" The omission of any mention of the acute angulation of the body-whorl also induces me to consider this species distinct; and, finally, Mr. Brazier having now sent me a specimen of this species marked "*Helix*, sp. nov. (only specimen): foot of Mount Owen Stanley Range, British New Guinea," strongly indicates that the two forms are specifically different, for it is very unlikely that he would have sent a specimen of his own species thus labelled.

Helix (*Geotrochus*) *lacteolota*. (Pl. XV. fig. 9.)

Testa conica, perforata, zonis pluribus lacteis et nigro-fuscis lacteo illitis cincta; anfractus 5, lineis incrementi obliquis striati, ultimus ad peripheriam rotundatus, infra convexiusculus, antice paulo descendens; apertura perobliqua, perist. versus purpureo-nigrescens, longe intus cærulea; peristoma album, undique expansum et paulo reflexum, margine columellari superne livido-fusco, late dilatato umbilicum partim obtegente.

Diam. max. 36 millim., min. 28, alt. 34.

Hab. Foot of Owen Stanley Mountains, British New Guinea.

This handsome species, in some respects, bears a considerable resemblance to *H. plurizonata*, Adams and Reeve, from

* *Vide* Ann. & Mag. Nat. Hist. 1883, vol. xi. p. 191.
† Proc. Linn. Soc. N. S. Wales, 1884, vol. ix. p. 805.
‡ Ann. Mus. Civico Stor. Nat. Genova, 1886, vol. iv. p. 21.

the island of Mindanao, Philippines. The basal aspect of that species (*vide* 'Voy. Samarang,' Mollusca, pl. xvi. fig. 9, or Reeve, 'Conch. Icon.' fig. 528), both as regards size and banding, is very similar to that of *H. lacteolota.* The latter, however, has a very much more elevated spire, a more raised body-whorl, and the volutions increase less rapidly. The coloured bands are eight in number on the last whorl; most of them are almost black and generally margined with brown and more or less blotched and smeared with an opaque cream-colour.

Helix (*Papuina*) *roseolabiata.* (Pl. XV. fig. 2.)

Testa imperforata, conica, trochiformis, alba, ad apicem nigrescens, ad peripheriam et circa suturam zona nigro-fusca cincta ; anfractus 5, primi duo convexi, cæteri convexiusculi, oblique rugose striati, ultimus acutissime carinatus, supra carinam paulo concavus, inferne planiusculus, similiter sculptus, antice prope labrum breviter descendens, ad aperturam contractus, intus lilaceus; apertura oblique producta, rostrata, irregulariter triangularis, intus alba, infra suturam quoque ad carinam nigro-fusco zonata; peristoma rosaceum, margine dextro in medio procurvo, breviter expanso, inferiore latius dilatato, columellari reflexo, appresso.

Diam. max. $30\frac{1}{2}$ millim., min. 24, alt. 19.

Hab. Ferguson Island, D'Entrecasteaux group.

This species has even a more rostrate aperture than *H. Tayloriana*, and is well characterized by its rosy lip, the acute keel around the periphery, and the marked contrast of the brown band upon the white ground.

Helix (*Papuina*) *Tayloriana*, Adams and Reeve. (Pl. XV. figs. 1, 1 *a*.)

This I believe to be a species which varies considerably both in form and colour, but not much in sculpture. The type, which is in the British Museum, is well figured (as regards shape) by Reeve *. The keel is, however, in some specimens even more acute, and the spire is concave instead of slightly convex. On the other hand, other examples are less acutely keeled, and the aperture is not so much produced or beaked. These constitute the *H. yulensis* of Brazier †, which in other respects, excepting small differences in the colour-markings, agrees with the typical form. A third variety (Pl. XV. fig. 1 *a*) has just been sent to the Museum

* Conch. Icon. fig. 524, *a–b*.

† Proc. Linn. Soc. N. S. Wales, 1876, vol. i. pp. 106 and 126.

by Mr. Brazier which seems quite distinct when placed side by side with the original *H. Tayloriana*, but which appears to be linked with it through *H. yulensis*.

It has a more convex body-whorl, especially above the periphery, which is also less sharply keeled.

The points in which all specimens agree are:—(1) the same kind of sculpture; (2) the black, *more or less* rostrate peristome; (3) the *more or less* acute cream-coloured keel at the periphery; (4) the pinkish-lilac tint upon the base of the last whorl towards the centre and upon that portion of it which lies between the terminations of the peristome.

Of ten specimens before me, two have black, two pinkish, and the rest pale apices. Some examples, like the type, have scarcely any colour-markings, some have interrupted spiral bands both above and below, others show interrupted oblique stripes, or both bands and stripes are intermingled confusedly in the same individual. With one exception all have two or more (more or less well defined) concentric zones on the lower surface.

The distribution of this species appears to be rather extended. The locality of the typical form was unknown to Adams and Reeve; but in the British Museum there is a specimen (Pl. XV. fig. 1) said to be from the D'Entrecasteaux group of islands, off the eastern extremity of New Guinea. The variety (*H. yulensis*) is met with at Yule Island, and the more convex form above described is, according to the specimens presented to the Museum by Mr. Brazier, from South Cape, British New Guinea. A single specimen of this form in the Museum is said to have been obtained at Ferguson Island, one of the D'Entrecasteaux group.

Helix (*Papuina*) *albocarinata*.
(Pl. XV. fig. 12.)

Testa breviter conica, imperforata, tenuis, semipellucida, pallide cornea, carina alba opaca cincta; anfractus 5, mediocriter convexi, oblique rugoso striati, ultimus ad peripheriam acute carinatus, inferne striis rugosis concentricis sculptus, lineis paucis interruptis albis opacis ornatus, antice breviter descendens, pone labrum luteo vel lacteo marginatus; apertura obliqua; peristoma album, anguste expansum et reflexum, margine exteriore sinuato, columellari incrassato, appresso, superne callo tenui labro juncto.

Diam. max. 24 millim., min. 20, alt. 17.

Hab. South Cape, British New Guinea.

This species comes from the same locality as the convex

form of *H. Tayloriana*, and resembles it considerably in form and sculpture, and, indeed, it may eventually have to be regarded as an albino variety of that form. The central keel is rather sharper and the texture more transparent than in *H. Tayloriana.*

Helix (*Papuina*) *Rollsiana.* (Pl. XV. fig. 3.)

Testa imperforata, conoideo-subglobosa, albida vel rubescens, prope suturam fusco notata, zonis fuscis diverse cincta, pone labrum aurantio strigata; anfractus 5, convexiusculi, striis obliquis confertis rugosis incrementique lineis sculpti, ultimus ad peripheriam antice subrotundatam, pone obtuse carinatam semper albo zonatus, inferne purpureo-roseo tinctus, antice breviter et subito descendens; apertura obliqua, subquadrata; peristoma album, tenue, late expansum et reflexum, margine superiore sinuato, columellari dilatato, appresso.

Diam. max. $30\frac{1}{2}$ millim., min. $21\frac{1}{2}$, alt. 20.

Hab. South Cape, British New Guinea.

The colour of this very pretty species in some respects appears to be very constant, whilst in other points it is variable. The periphery in the four specimens at hand is encircled by a more or less broad white zone, and the body-whorl always exhibits an orange stripe just behind the broadly expanded lip, which is constantly white. Another persistent feature is the purplish rosy portion of the base between the umbilical region and the extremity of the outer lip. The ground-colour of the shell is usually whitish or of a pinkish tint, and somewhat freckled with minute oblique opaque white dots and lines, and the apex may be white or blackish. The spiral bands are rather variable, numbering from one to three above the periphery and two to four below it. The sculpture is of the same character as that of *H. Tayloriana.* I have named it, at Mr. Brazier's request, after Mr. Rolls, who, accompanied by Mr. Goldie and others, whilst exploring certain parts of New Guinea, collected these specimens.

Helix (*Trochomorpha*) *Belmorei*, var.
(Pl. XV. figs. 8, 8 *a*.)

Testa late et perspective umbilicata, depresse conico-orbicularis, mediocriter crassa, corneo-fusca, infra peripheriam pallidiorem zona lata saturate fusca ornata; anfractus 6, planiusculi, vix convexi, oblique striati, supra suturam compressi, concavi, regulariter accrescentes; ultimus in medio acutissime carinatus et compressus, inferne paulo convexus, antice haud descendens; umbilicus latus, profundus; apertura horizontalis, intus albescens;

peristoma superne mediocriter tenue, subrectum, inferne incrassatum, recedens, marginibus callo tenui junctis.
Diam. max. 29 millim., min. 26, alt. 12.

Hab. North-east end of Malayta Island, Solomon group.

The specimens from the above locality are very closely allied to the type of *Helix Belmorei*, Cox *, from Hoki Island, also one of the Solomon group. They differ in being more depressed and consequently more sharply angled at the periphery, and they have not the "irregular longitudinal striæ" (which might be more explicitly described as irregular impressed spiral lines) upon the base. The type of *H. Belmorei* was presented to the British Museum by Dr. Cox, and from an examination of it I am inclined to think that these impressed lines are rather an individual characteristic than a specific feature. I therefore think it advisable to consider the specimen sent by Mr. Brazier as a variety of this species until we have a larger series of the typical form to prove them distinct. *H. merziana* has a more convex upper surface, is smaller, and the last whorl expands at the aperture.

Megalomastoma Brazieræ. (Pl. XV. fig. 15.)

Braziera typica, Brazier, Proc. Linn. Soc. New South Wales, 1883, vol. viii. p. 35.

Testa pupiformis, solida, anguste umbilicata, pallide fuscescens, oblique striata; anfractus 7, convexi, penultimus inflatus, ultimo latior, ult. angustatus, valde oblique descendens, prope labrum subito ascendens, circa umbilicum subfuniculatus; apertura circularis, luteo-albida, longit. totius $\frac{1}{3}$ paulo superans; peristoma albidum, incrassatum, reflexum, marginibus callo crassiusculo junctis.
Longit. 23 millim., diam. 11, apertura 8 lata.
Operculum corneum, multispirale.

Hab. Ferguson Island, D'Entrecasteaux group, south-east of British New Guinea.

The species here described was exhibited by Mr. Brazier at the Linnean Society of New South Wales as representing a new genus, and he proposed to name it *Braziera typica*. After due consideration I have failed to find good reasons for separating it from *Megalomastoma*. In shape it is very like *M. Gundlachi*, Pfeiffer. It has, however, a more contracted umbilicus, and the peristome is differently connected with the body-whorl. The fact of this species being from New Guinea, whereas *Megalomastoma* mainly comprises West-Indian forms,

* Proc. Zool. Soc. 1871, p. 647, pl. lii. fig. 12.

is not sufficient, I think, to warrant the erection of a new genus for its reception. The front of the body-whorl above the aperture is very slightly flattened, as in the species of *Hybocystis*, which, however, are furnished with shelly opercula.

As it was Mr. Brazier's wish that this shell should be dedicated to the memory of his late wife, I have named it *Megalomastoma Brazieræ*; however, should further investigation prove that the animal differs from that of *Megalomastoma*, I would propose that the name originally assigned to this species by Mr. Brazier (although no description of it was then published) should be retained.

Helicina novo-guineensis. (Pl. XV. figs. 11, 11 *a*.)

Testa depresse trochiformis, acute carinata, flavescens, plus minus rufo maculata et strigata vel flammulata, spiraliter lirata et sulcata, incrementique lineis sculpta; anfract. 5–5½, parum convexiusculi, ultimus supra et infra æqualiter convexiusculus, carinam infra liris tenuioribus concentricis ornatus, in medio callo albo obtectus; apertura subhorizontalis, triangularis, ad basim pone columellam lira parva ab margine divergenti instructa; peristoma album, anguste expansum. Operculum utrinque purpureo-rubidum, ad marginem columellarem pallidum.

Diam. max. 18 millim., min. 15½, alt. 12½.

Var. Testa maxima (fig. 11 *a*).

Diam. max. 25 millim., min. 21, alt. 15.

Hab. Foot of Owen Stanley Mountains.

This species is well characterized by the spiral liræ, which are much coarser on the upper surface than beneath. There are about twelve upon the last whorl above the rather sharp keel, and about twenty below. The ridge within the aperture, which appears to act as a rest for the operculum, is rather strongly developed. The ground-colour of this shell is generally more or less yellowish; a series of bright red spots ornament the carina and the suture, and radiating lines and undulating streaks occur both on the upper and under surfaces of most specimens. Some examples are more uniformly yellow and have only faint traces of the red markings.

Helicina solitaria. (Pl. XV. fig. 10.)

Testa parva, breviter conica, albida, zonis duabus (altera supra medium anfract. ultimi altera infra) rufescentibus, plusve minusve interruptis cincta; anfract. 5, vix convexiusculi, spiraliter striati, ultimus ad peripheriam filo-carinatus, infra angulum convexus, concentrice striatus, in medio callo tenui albo indutus; apertura paulo obliqua, intus rubescens, basi circa columellam flavida;

peristoma tenue, antice parum effusum, flavescens; columella inferne subdentata.
Diam. max. 10 millim., min. $8\frac{1}{2}$, alt. 8.

Hab. Foot of Mount Astrolabe, British New Guinea.

Only a single specimen was obtained by Mr. Goldie at the above locality. It is white, varied with a few transparent spots, and an interrupted band of a reddish tint upon the upper part of the last whorl and another on the under surface. The columella forms an angle or almost a tooth at the lower part, where it unites with the basal portion of the peristome.

EXPLANATION OF PLATE XV.

Figs. 1, 1 *a*. *Helix* (*Papuina*) *Tayloriana*, Adams and Reeve.
Fig. 2. *Helix* (*Papuina*) *roseolabiata.*
Fig. 3. *Helix* (*Papuina*) *Rollsiana.*
Fig. 4. *Helix* (*Acavus*) *coraliolabris.*
Fig. 5. *Nanina Cairni.*
Fig. 6. *Nanina Hunsteini.*
Fig. 7. *Helix* (*Acavus*) *latiaxis*, Smith.
Figs. 8, 8 *a*. *Helix* (*Trochomorpha*) *Belmorei*, Cox, var.
Fig. 9. *Helix* (*Geotrochus*) *lacteolota.*
Fig. 10. *Helicina solitaria.*
Figs. 11, 11 *a*. *Helicina novo-guineensis.*
Fig. 12. *Helix* (*Papuina*) *albocarinata.*
Fig. 13. *Nanina exilis*, Müller, jun.
Fig. 14. *Helix* (*Sphærospira*) *Rehsei*, Martens.
Fig. 15. *Megalomastoma Brazieræ.*

LIV.—Sporendonema terrestre, *Oudemans, an example of Endogenous Spore-formation among the Hyphomycetes.* By C. A. J. A. Oudemans *.

It is one of the characters of the true Moulds or Hyphomycetes that their spores or conidia are not produced *in* sporidia, but by the upper parts of erect threads, that is to say free, not enclosed, or, as has been said, *exogenously*. The conidia are composed of one, two, or more cells—sometimes singly, but sometimes also placed together in more or less considerable numbers, or again united into longer or shorter chains. In the last case, the conidia which are situated furthest from their origin are the oldest, and those nearest the origin the

* From the 'Verslagen en Mededeelingen der Koninklijke Akademie van Wetenschappen; Afd. Natuurkunde.' Derde Reeks, Deel ii. Amsterdam, 1886, pp. 115-122.

youngest, and the union between the conidia of the same chain is reduced to such small dimensions that one may use the word "unthreading" to indicate the readiness with which the consecutive subdivisions separate from each other. Fine examples of chains of conidia are to be found in the genera *Aspergillus*, *Sterigmatocystis*, and *Penicillium*.

It must strike every one that the conidia are essentially nothing but the upper parts of the threads which serve to support them, but, for the attainment of the purpose for which they are formed, separated from the lower parts by a diaphragm or by a process of constriction leading to complete separation. Produced for the purpose of multiplication, they needed to be separated from the threads whose limited life they cannot share, in order the better to lead an independent existence.

It may be supposed, and certainly not without reason, that in the above-mentioned tops of the threads some process goes on within the protoplasm by which the greater tenacity of life in these tops is caused and their capacity to grow into new plants is provided for; and, reasoning onwards, the supposition may be entertained that such a top, after separating or dropping from the parent thread, ought to consist of two parts, namely: 1, a spore or a conidium; and, 2, a membrane surrounding the latter. Microscopic examination, however, shows nothing of any such division into two constituent parts, and hence also it is that both the present and former mycologists have never been able to agree in the theory that the spores, in order to occur upon erect threads, should be produced as independent grains within the threads.

In saying "never" we fall, however, into an historical error. In fact, about the year 1826 Desmazières stated that he had met with a case of endogenous spore-formation, so that he felt justified in proposing for the fungus which exhibited the phenomenon a new name, and indeed that of *Sporendonema*, in place of the names *Mucor*, *Ægerita*, *Oïdium*, and *Sepedonium*, by which the plant had previously been indicated generically. In full this was described and distributed in dried specimens under the name of *Sporendonema Casei*, as, for example, in the 'Plantes Cryptogames du Nord de la France' (No. 161). It is found, in fact, only upon the crusty surface of cheese which has been kept for a considerable time in the cellar. It then forms light cinnabar-red soft cushions which are very convenient for microscopic examination, and have therefore, since Desmazières's statement, been more frequently subjected to examination than formerly.

Desmazières gave an account of his discovery in the fol-

lowing words:—"It is from this examination that I created the genus *Sporendonema*, and recognized that the single species that it at present contains has, as its essential character: tubes or filaments short, simple or branched, continuous, nearly transparent, erected, grouped, one hundred and twentieth of a millimetre in thickness, containing in their interior, and almost always throughout their whole extent, very large reddish rounded sporules, slightly unequal in diameter, and often very close together and pressed against each other, but placed end to end upon a single line, so that the filaments appear as if furnished with very closely approximated dissepiments." The author proceeds:—"The escape of the sporules takes place at the apex of the filaments, which, after their dissemination, become quite transparent and a little narrower. Sometimes, however, the sporules are set free by the destruction of the excessively delicate membrane of which these plants are composed."

The results of Desmazières's investigations upon the cheese-mould met with no contradiction until 1838. Then, however, Corda, in the second part of his 'Icones Fungorum' (p. 8), stated that he could not agree with the French mycologist, and that the phenomenon of endogenous spore-formation was never observed by him in the numerous examples of *Sporendonema Casei* that he had examined with the greatest care. He declared that he had never seen anything but chains of spores, just such as he ascribed to the genus *Torula*.

It must be remarked, however, that the figure which is given by Corda with his text (pl. ix. fig. 36) does not at all agree with the structure of the *Sporendonema*-plant as it is to be found in Desmazières's 'Plantes du Nord de la France' (figs. 5 & 6), so that it is not too bold to infer that the two mycologists investigated different Fungi; for which reason, therefore, Corda's *Torula Casei* is not to be regarded as synonymous with Desmazières's *Sporendonema Casei*. The person who made this observation was Berkeley (Ann. & Mag. Nat. Hist. ser. 2, vol. v. p. 460), and I have had the opportunity of convincing myself of its correctness.

With the conclusion just expressed, the importance which otherwise would attach to Corda's investigation falls to the ground. On the other hand, however, the correctness of Desmazières's deduction can by no means be inferred from the negative result of Corda's investigation. Berkeley, in the same part of the above-cited Journal, showed upon good grounds that the genus *Sporendonema* had no *raison d'être*, and that *Sporendonema Casei* must be removed into the genus *Torula*. On account of the difference between the Fungi in-

vestigated and described by Desmazières on the one hand, and by Corda on the other, and seeing that the last-named author had already employed the name *Torula Casei*, another name had to be invented for the typical *Sporendonema Casei*, and that of *Torula sporendonema* was selected for it by Berkeley. This contradiction in terms can only be accepted from a describer's and not from a logical point of view.

Desmazières's error consisted in this: in his *Sporendonema*-threads he had regarded the red contents of the joints, which contrasted strongly with the colourless walls, as spores, and had overlooked the dissepiments which really existed. Further, his notion that the tops of the *Sporendonema*-threads become colourless in consequence of the evacuation of the red spores previously enclosed in them was shown to be incorrect *; and the escape of the spores at other parts of the thread might equally well be regarded as in accordance with the truth. The presence of dissepiments and the interruption of the threads at the level of these dissepiments seems to be common to *Sporendonema* and *Torula*, and in accordance with this there can no longer be any notion of perfect spores enclosed in the threads of the fungus under examination.

Among the older writers who accepted Desmazières's observation as correct, we may name, as one of the most celebrated, Elias Fries. He even goes so far as to include *Achlya prolifera*, a Saprolegniacean, which, however, at that time, had been only very briefly described, under the new genus, and to refer to it also the known *Torula epizoa*, giving it the name of *Sporendonema Sebi*. All these erroneous determinations were corrected by later mycologists furnished with better instruments; but at the same time *Sporendonema* was finally erased from the list of genera in the department of Fungi.

Under these circumstances it cannot excite any astonishment that I was exceedingly surprised when, some weeks ago, I found in a tan-bed in one of the hothouses of the Amsterdam Botanical Garden some lumps of earth covered with a network of threads, partly white, partly brownish, the constituents of which, upon careful examination, appeared to me to satisfy the chief requirements of the genus *Sporendonema* established by Desmazières, but consigned to oblivion by later writers.

The above-mentioned network consisted (fig. 1) partly of creeping and partly of erect, colourless, irregularly branching threads, of which the former, as usual, represented the vege-

* The colourlessness of these tops may merely be due to the fact that no dissepiments are as yet formed, and no coloured protoplasm has yet been produced.

tative part, or the mycelium, and the latter the generative part. Both were generally beset with extremely fine raphides of some calcareous salt (not carbonate of lime). In the creeping threads I found dissepiments, but not in the erect ones. Now, however, it appeared that the latter, charged with the spore-formation, bore these spores not at their tips, or in lateral branches, and did not produce them by separate constrictions or in chains, but really developed them in their interior. At regular distances (fig. 2) colourless denser parts

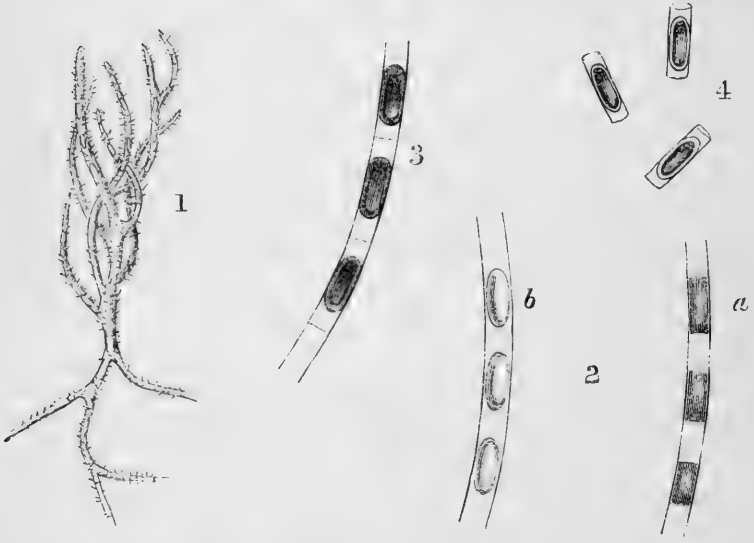

Fig. 1.—Plant of *Sporendonema terrestre*, Oud., enlarged (diagrammatic).
Fig. 2 *a*.—Part of an erect thread, with the commencement of spore-formation; ends of the colourless masses of protoplasm truncated. × 1000.
Fig. 2 *b*.—Part of an erect thread with light brown spores, the ends of which are already rounded off. × 1000.
Fig. 3.—Erect thread with spore-formation completed. × 1000.
Fig. 4.—Separate mature spores. × 1000.

(little clumps of condensed protoplasm) are formed; these gradually acquire a brown tint, and then the two flat surfaces by which they were originally bounded at their two poles (fig. 2 *a*) become rounded off (fig. 2 *b*), in consequence of which at last the somewhat elongated oval form (fig. 3) is attained. I found the wall of the mature spore to be rather thick.

It was further particularly remarkable that the spaces be-

tween the different spores not only remained empty and therefore colourless and transparent, but at last they were marked by a circular division just in the middle (fig. 3), in consequence of which the threads broke up into fragments (fig. 4), each of which showed a sporiferous part in its middle and two short tubular appendages. In our case, therefore, there can no longer be any doubt as to the endogenous formation of the spores, and we are justified in reintroducing the genus *Sporendonema* and naming the species observed *Sporendonema terrestre.*

The question whether any dissepiment is to be seen at the place of the circular division must be answered in the negative. Moreover, no trace of dissepiments is to be seen between the spores and their tubular appendages.

Before concluding, I may be allowed to remind the reader that the formation of spores within the threads of some Hyphomycetes has been previously observed, but that the phenomenon was always confined to the threads of the mycelium. The bodies capable of germination were regarded (none the less on account of their form differing from the ordinary appearance of the true spores) less as spores than as a sort of brood-buds, and they were never seen to be set free unless the walls of the thread in which they were produced had disappeared. This formation cannot, of course, be placed in the same line with that observed by us, and therefore does not detract from the singularity of the phenomenon that we have observed.

We may remark, further, that our fungus is one of those which stand on the boundary between the "white" and "black" moulds of the English authors, the Mucedineæ and Dematiei of the Latin-writing mycologists, or, in other words, which combine in themselves the colourless threads of the first with the darker-coloured spores of the second group. In accordance with custom, however, such forms are to be inscribed under the Mucedineæ or "white moulds."

That the name of "conidia," which applies exclusively to exogenous germ-granules, cannot be employed for the endogenous granules of our *Sporendonema terrestre* is a matter of course. There is no reason, we think, to refuse the name of spores to these productions. In this respect, also, our fungus therefore holds a middle place between two very different groups of Fungi, but now between a lower group, with which it agrees in its simple structure, and a higher one, the more complex forms of which are at once distinguished by the formation of endogenous spores.

Of the higher fungus with which our mould may stand in

genetic relation we know nothing. It is, however, the case that our knowledge of this relation, in an exceedingly large number of moulds (including the Dematiei), is still so obscure that we cannot accept the opinion of those who think that the Fungi, even now, ought not to be included in any system. This mode of treatment leads to the neglect of the generally very fine and, in any case, very important forms which belong to it, and thus to a decline of our knowledge of these plants which they do not deserve. Besides, following Fuckel, we can contrast with the series of "Fungi perfecti" a series of "Fungi imperfecti," and thus reconcile the two opinions.

The production of circular divisions on the fertile branches of our fungus is likewise one of its remarkable peculiarities. The phenomenon is of comparatively rare occurrence. Among the Algæ it is observed in the Œdogoniaceæ, and among the lowest of all organisms in *Bacillus subtilis* (among the Schizomycetes) and in the Mucorineæ. In the Hyphomycetes no case of the kind had hitherto been observed.

The diagnosis of our Fungus must run as follows, according to what has been stated:—

Sporendonema terrestre, Oud.

Mycelio in terra humosa repente albo, articulato, ramoso; hyphis fertilibus erectis, ramosis, continuis. Sporis endogenis, a se invicem remotis, ex hypharum fertilium protoplasmate ortis, primitus achromis, utrinque planis, postremo fuscis, utrinque rotundatis, manicatis, *i. e.* tubulo membranaceo brevi, achromo, ex hypharum interstitiis vacuis circumcisione orto ornatis. Longit. sporarum 7 μ, latitudo earum $2\frac{1}{3}$ μ, absque appendiculis maniciformibus.

LV.—*Descriptions of new Species of Moths (Noctuites) from the Solomon Islands.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

THE following new species are from the collection recently sent home by Mr. C. M. Woodford.

Ommatophoridæ.

1. *Nyctipao variegata*, sp. n.

♀. Nearest to *N. crepuscularis*, decidedly larger; the ocellus of primaries as in *N. ephesphoris* and bounded by a

broader bone-yellowish belt than in *N. crepuscularis*; the transverse pale stripe crossing the angle of this belt very indistinct and quite perpendicular, instead of slightly oblique; the seventh spot of the submarginal zigzag series considerably enlarged: secondaries entirely different, the basal area pale sordid buff, gradually changing to vinous brown before the middle, with a large apical darker brown patch interrupted by the usual cuneiform, subcostal, apical, white spot, which is, however, twice as large as in *N. crepuscularis*; basal fourth crossed by a blackish-brown stripe; a nearly straight diffused dark brown stripe across the middle; six submarginal black spots with whitish sigmoidal or lunate inner borders: abdomen with no basal brown band or subbasal white band, pale greyish brown or dove-coloured, with yellowish base and sides. Under surface quite unlike that of *N. crepuscularis*, pale sandy buff, with a more or less arched purplish-brown stripe before the middle of all the wings and a broad external border of the same colour enclosing a zigzag series of large white spots: primaries with a white crescentic spot at the end of the cell: secondaries with a dark brown angular discocellular spot: body below sandy buff, the anterior half of the pectus ochraceous. Expanse of wings **119** millim.

Alu, Shortland Island.

2. *Nyctipao caliginea*, sp. n.

♀. Allied to *N. ephesphoris*, *leucotænia*, and *dentifascia*, but readily separable from all three by its slightly superior size, the distinctly broader external area, the much more angular white band across the primaries, the wider white band across the secondaries, the white and whitish zigzag series of markings on the external area well separated from the white band, the more purplish tint of, and better defined black stripes on, the basal area: the white apical spots resemble those of *N. ephesphoris*; on the under surface the white spots are large, as in *N. ephesphoris*, but the sixth spot of the primaries and the fifth of the secondaries are projected forward towards the outer margin, as in *N. dentifascia*. Expanse of wings 119 millim.

Alu.

Thermesiidæ.

3. *Sonagara superior*, sp. n.

♂. Allied to *S. strigosa*, Moore (Descr. Atk. p. 180, p. v. fig. 17); decidedly larger. Wings above sericeous

pale sandy brownish, reticulated with grey: primaries with blackish costal dashes, a minute black point at the inferior angle of the cell; an oblique straight brownish streak from outer third of inner margin to apex: secondaries with a narrow, ill-defined, brownish central band; a black spot at the end of the cell: body pale sandy brownish, darker in front. Under surface slightly paler and yellower than above, reticulations less distinct, brown stripe of primaries ill-defined; band of secondaries wanting, a well-defined black spot at the end of each discoidal cell; palpi and front of pectus brownish. Expanse of wings 22 millim.

Alu.

Erosiidæ.

4. *Erosia mutans*, sp. n.

♀. Allied to a Ceylonese species (see Moore's Lep. Ceylon, pl. clxxxvi. fig. 7) of the same general tints and pattern, but larger, with broader primaries and differently formed discal stripe on these wings: primaries from base to discal stripe pale sericeous brown, mottled with grey; external area ash-grey, mottled with slate-grey; discal stripe whitish, changing to cupreous in certain lights, straight and transverse from costa to lower radial, thence acutely angulated, running in a double zigzag to near external angle, its inferior extremity forming the outer boundary of a subpyriform, black-bordered, grey spot on the inner margin; a submarginal series of black spots bordered with whitish, changing in certain lights to cupreous; fringe similarly coloured: secondaries slate-grey, with two submedian divergent streaks from the base, an acutely angulated stripe beyond the middle, a sinuous submarginal stripe and the fringe whitish, changing to cupreous; the basal area (excepting the cupreous streaks), the inner border of the posterior portion of the postmedian stripe, and a cuneiform patch connecting its anterior portion with the outer stripe blackish brown; submarginal stripe imperfectly bordered externally with black: face bronze-brown; vertex of head and antennæ silvery white, collar dark brown, thorax and tegulæ whitish; abdomen grey, with a black transverse basal stripe. Under surface wholly leaden grey, with indistinct darker mottling on the wings; the costa of secondaries with coarse blackish fringe. Expanse of wings 24 millim.

Alu.

The above may belong to the group named *Dirades* by Walker, in which the sexes differ in the shape and slightly in

the pattern of the secondaries. The following is undoubtedly a *Dirades* :—

5. *Dirades aluensis*, sp. n.

Allied to *Erosia theclata*=*E. adjutaria* (females of *Dirades binotata*) ; the sexes of the same general shapes and colours ; male vinous brown : primaries with blackish costa ; a semicircular black spot beyond the middle of inner margin ; an oblique subapical blackish dash and an interrupted pale-edged black submarginal line ; apex black on the fringe : secondaries with the basi-internal half bounded externally by a whitish line, which is elbowed just before it reaches the abdominal margin ; the inferior half of the basal area bounded by a black line, its anterior half also being bright copper-red and its posterior half grey ; abdominal fold white ; fringe from apex to second caudate angle black. The female is greyer than the male, and, owing to the greater width of the secondaries, the angle of the line bounding the basal area is formed in the middle of the wing ; the red longitudinal band from the base is darker and duller, and the whole of the remainder of the wing is grey, with the exception of a black-edged spot on basi-internal half : body greyish brown, with the antennæ and tegulæ whitish. Under surface pale brown, the secondaries paler than the primaries ; the male of a more golden brown than the female. Expanse of wings, ♂ 18 millim., ♀ 20 millim.

Alu.

Hypenidæ.

6. *Hypena iridis*, sp. n.

Primaries above brown, the basal two thirds shot with lilac in certain lights, bounded externally by a black transverse line (on the inner side of which the shot-colouring is wanting so as to leave a band of the ground-colour) edged externally with snow-white, immediately following which is a diffused band of lilacine scales ; a marginal series of whitish and black dots ; fringe whity brown, tipped with dark grey and with two central wavy dark grey lines : secondaries grey-brown, with a darker marginal line ; fringe whiter than in primaries ; costal border whitish : body brown. Under surface sericeous greyish brown ; wings with a black marginal line ; fringes as above. Expanse of wings 30 millim.

Nearest to *H. iconicalis* from Ceylon, Java, &c., with similar palpi.

7. *Hypena sylpha*, sp. n.

Allied to *H. molpusalis*, from Ceylon (=*H. sparsalis*, from Java); smaller and more slender, with differently formed central band across primaries: these wings are lilacine grey, crossed near the base by an ill-defined black line; a partly black-edged cuneiform brown patch from cell to inner margin, where it unites with a brown band running across the middle of the wing; this band is edged externally by a black and whitish feebly biangulated stripe; discoidal spots blackish, the reniform spot having a pale centre; three or four whitish crescents in an oblique series beyond the cell and a discal series, parallel to the outer margin, of blackish spots bounded externally by whitish crescents; a marginal series of blackish crescents bounded internally by whitish dots: secondaries greyish, with blackish marginal line; fringe whitish, spotted from apex to beyond the middle with white-centred black spots: body above greyish, darker in front. Under surface sericeous greyish; wings with a black marginal line; fringe blackish, with interrupted slender basal white line. Expanse of wings 21 millim.

Alu.

The delicate palpi of this species and *H. molpusalis* seem to me to indicate a generic distinction between this species and the preceding one; but, until the whole genus *Hypena* can be thoroughly revised, it is of no use to attempt to separate isolated species. Distinctive characters which, at first sight, appear to be trustworthy may prove to graduate one into another.

Herminiidæ.

8. *Epizeuxis minima*, sp. n.

Bone-whitish, irregularly transversely banded, but especially beyond the middle, with rufous-brown; the basal two thirds of primaries being almost clear in the type, interrupted chiefly by indications of a slightly zigzag central band, the outer edge of which is marked by a whitish line bounded towards costa by a blackish dash; costa black-spotted; a conspicuous black spot just below the middle of the disk, and three blackish spots connected by brownish ring-spots on outer margin; fringe ochraceous, the outer half paler, tipped with grey, the inner half varied with rufous-brown: secondaries with two black dots on an ill-defined rufous spot in the cell; a marginal chain-like border of brown ring-spots as in primaries; fringe also similar to that of those wings: body whitish, palpi tipped and banded with blackish. Under surface shin-

ing white, with the outer half of the wings transversely striped and clouded with grey; fringes ochreous, tipped with grey and traversed by a line of the same colour. Expanse of wings 18 millim.

Alu.

9. *Aginna notata*, sp. n.

♀. Pale flesh-coloured or whity brown suffused with pink; a slightly browner diffused border to all the wings: primaries with a minute black dot at the end of the cell, a few black scales sprinkled transversely across the disk, terminating in a well-marked blackish spot near external angle; a marginal series of black dots: secondaries with whitish costal area; a grey spot at end of cell; an indication of four dots, in blackish scales, crossing the median branches obliquely at about one third the distance from the cell to the outer margin and three more, the third better defined, at two thirds; a submarginal grey streak near anal angle. Under surface of wings with a conspicuous black dot at the end of each cell, and an imperfect transverse discal series of unequal, more or less defined grey or blackish spots. Palpi and legs brownish externally. Expanse of wings 50 millim.

Alu.

10. *Aginna erebina*, sp. n.

♂. Smoky brown: primaries faintly tinted with lilacine on basal half; two widely divergent dentate-sinuate black lines, the first across the basal fourth, the second across the external two fifths, and between them a black imperfect reniform spot in outline; a straight, slightly oblique yellowish line across the disk; a marginal series of conical black spots; fringe traversed externally by a pale grey line: secondaries with a dusky spot at end of cell followed by an oblique dusky stripe; a slightly sinuous yellow stripe across the disk, bent upwards near anal angle; marginal spots and fringe as in primaries: palpi pale ochreous; abdomen greyish, with narrow whitish edges to the segments. Under surface very dark, smoky brown; wings with conspicuous black spots at the extremities of the discoidal cells, an arched or bent blackish stripe beyond the middle, and a somewhat dentated pale-bordered discal blackish stripe; marginal spots and fringes as above: legs clothed with dense masses of black-brown appressed hairs. Expanse of wings 46 millim.

Alu.

Though coloured like a *Herminia* the structure of the antennæ, palpi, and legs proves it to be a true *Aginna*.

11. *Bocana stellaris*, sp. n.

Allied to *B. æsopusalis* (of which *Diomea bryophiloides* is a distorted specimen): primaries sericeous grey-brown, bronzy in certain lights, crossed at about basal fourth by a crinkled black line; reniform spot white with black edges; an arched denticulated white-edged blackish line beyond the middle; a zigzag series of more or less connected white spots and crescents near outer margin, and a marginal series of triangular jet-black spots, relieved on the fringe by a series of subconfluent white spots: secondaries paler and greyer than primaries, with a white-bordered angular grey line beyond the middle, and a second, abbreviated, towards anal angle; a slender black marginal line followed by a white line at the base of the fringe: thorax slightly ochreous, brown; abdomen grey, with two or three white dorsal spots. Under surface brownish grey, with a faint lilacine tint in certain lights; all the wings with a black-edged white spot at end of cell, and two more or less irregular black discal lines, the outer one interrupted, more or less separated into distinct spots and white-edged externally; a slender black marginal line, followed by a slender white line at the base of the fringe: body below golden brown. Expanse of wings 24 millim.

Alu.

12. *Egnasia ænea*, sp. n.

Primaries whity brown, with brassy reflexions; costal border blackish at base; orbicular spot small, black; reniform spot large, C-shaped, black; two black dots towards base of interno-median area; a longitudinal white streak, interrupted by the ordinary black spots, through the discoidal cell; an irregularly sinuous white discal band, bounded on both sides by a series of subconfluent black spots; external border suffused with smoky brown: secondaries of male white, with a subquadrate basi-internal blackish patch, a black discocellular spot, a black discal line, its central third arched outwards, and a tolerably broad external brown border following the discal line so as to leave a band of white between; secondaries of female either as in the male or with the basal area as far as the discal line brown: face, vertex of head, and mesothorax brown, remainder of body white; terminal joint of palpi and antennæ yellow. Under surface whitish varied with testaceous, the latter colouring replacing the brown of the upper surface; black markings ill defined; the whole surface of the wings sericeous, with brassy reflexions. Expanse of wings 18–26 millim.

Alu.

Allied to "*Hypenodes*" *jucundalis* of Snellen (Tijd. voor Ent. 1886, pl. v. fig. 10); but I do not see how it differs from *Egnasia*, and it certainly has little in common with *Hypenodes*.

13. *Ballatha elegans*, sp. n.

Allied to *B. atrotumens* *: primaries above pearl-grey, suffused towards base and on costal area towards apex with brownish; a broad oblique white belt from costa before the middle to the external angle, whence it curves upwards to apical third of outer margin, whence to apex it becomes very narrow and obscure; the projecting patch of scales just beyond the middle of inner margin elliptical, blue-grey and black spangled with silver; a few scattered silver scales on basal area and others indicating the ordinary position of the discoidal spots, a few bounding a brownish costal patch immediately beyond the white belt; a silver stripe forming the inner boundary of the brownish apical patch; a brighter silver lunulated marginal stripe; fringe grey; subapical ocellus large, oval, black, with linear yellowish pupil and iris of the same colour; a small black apical spot: secondaries clear, soft, golden ochreous, paler on the costa and fringe; a diffused grey apical patch: head and collar testaceous, with micaceous shining scales on the face and vertex of head; tegulæ slightly greyer with similar scaling; thorax grey; antennæ whity brown; palpi ochreous; abdomen pale, soft, ochreous. Under surface bright clear ochreous, the body whitish, the legs tinted above with ochreous; primaries with an oblique, abbreviated, broad, dark grey band on the disk. Expanse of wings 40 millim.

Alu.

This is by far the most beautiful species of this singular genus hitherto described.

LVI.—*New Infusoria from New Zealand.* By T. W. Kirk.

Opercularia parallela.

Body slender, about three times as long as broad; sides parallel for about two thirds of their length from the margin, then tapering rapidly to the pedicle. Peristome border not,

* A species of the same genus has been described and figured as an *Epizeuxis*! by Snellen (Tijd. voor Ent. 1879, p. 130, pl. vii. fig. 1).

or but slightly, thickened. Ciliary disk moderately elevated, cilia in a single row. Endoplast curved, band-like, nearly transverse. Cuticular surface granular. Contractile vesicle single, near anterior margin. Pedicle annulated, branched. Length of body $\frac{1}{350}$ inch.

Hab. Pond in Botanic Garden, Wellington.

Similar to *O. cylindrica*, but more cylindrical, and rough without striæ.

Acineta simplex.

Lorica wine-glass-shaped, anterior edge not narrowed, lip not reversed, posterior extremity rounded, sides nearly parallel; pedicle moderately stout, about twice as long as the lorica. Animalcule occupying the anterior half of the lorica, subspherical. Tentacles capitate, arranged in two groups of about ten in each. Contractile vesicle situated on one side, near the anterior margin. Length of lorica $\frac{1}{500}$, width $\frac{1}{600}$ inch.

Hab. Botanic Garden and Karori Reservoir, Wellington.

New-Zealand Vorticellæ.

In vol. xviii. of the 'Transactions of the New-Zealand Institute' is a paper on this subject by myself. The following species are identified. Although the antipodean specimens differ slightly from the figures and descriptions given in Saville Kent's manual, I have no doubt they belong to the species named.

Vorticella annularis, *Müller.*
—— marina, *Greeff.*
—— longifilum, *Saville Kent.*
—— campanula, *Ehrenberg.*
—— cratera, *Saville Kent.*
—— citrina, *Ehrenberg.*

Vorticella elongata, *De Fromentel.*
—— patellina, *Müller.*
—— nebulifera, *Ehrenberg.*
—— striata, *Dujardin.*
—— aperta, *De Fromentel.*

The following are described as new:—

Vorticella oblonga.

Body oblong, nearly twice as long as broad, rounded nearly equally at both ends, encircled by a number of interrupted lines looking like puckers. Pedicle stout, four times as long as the body, contracting by loops, and apparently too weak to support the body for long in an erect position, as it gradually leans either to one side or the other till it meets with some

object, where it rests for a short time, and then resumes the upright attitude. A large species, attached to seaweed.

Vorticella zealandica.

Body attenuate, from two to three times as long as the greatest breadth, tapering downwards, considerably constricted below the peristome, then swelling for rather more than half the length, when it again becomes constricted; then a nearly circular swelling, giving the posterior end an unusually blunt appearance.

Apparently striated perpendicularly; but of this I am not certain, as at some times the striations were seen, while at others they disappeared, as though at the will of the animal. Pedicle slight, four times the length of the body. Length of body $\frac{1}{200}$ inch.

Hab. Pond in Newtown Park, Wellington.

LVII.—*Descriptions of new Species of* Epitola *from Cameroons &c. in the Collection of Henley Grose Smith.* By W. F. Kirby, F.E.S.

In order to avoid the premature multiplication of genera I employ *Epitola* in the extended sense in which it was used by the late Mr. Hewitson; but it must not be forgotten that there are three very distinct forms in the genus:—(1) *Epitola elion*, Doubl. & Hew. (the type), a large insect, with the hind margin of the fore wings strongly emarginate; (2) *E. ceraunia*, Hew., a smaller insect, with rather long fore wings and the hind margin oblique and less strongly emarginate; and (3) the comparatively small species with rounded wings which form the bulk of the genus as it stands at present. I believe the last are sometimes arranged under *Phytala*, with the type of which they have also but little resemblance.

Epitola urania.

Expands $2\frac{2}{3}$ inches.

Male.—Fore wings: costa strongly arched, tip rounded and produced, the hind margin deeply concave and then rounded to the inner margin. Hind wings rounded, more obtusely towards the inner margin.

Wings rich blue, shading into purple towards the edges;

costa black as far as the subcostal nervure, but the blue extending nearly to its edge for about the middle third of its length; apical third of costa black, its boundary, except that the blue projects slightly into it beyond the cell, falling nearly straight to the extremity of the hind margin, where the black border narrows and disappears. Hind wings with a narrow black border, extending round the hind and inner margins, narrowest on the lower half of the hind margin. Underside: fore wings light brown, varied with grey, and, towards the tips, with purplish and bronzed reflections; extremity of the cell with two whitish spots, the largest within the cell, the other forming the middle of a curved series of five spots, the four outermost being bright blue; beyond these is another row of five whitish spots, two near the costa and three towards the hind margin, the series being interrupted between; but between this empty space and the hind margin are four more whitish spots, arranged in pairs. Hind wings iridescent purple and yellow, the costa bright golden yellow above the subcostal nervure to nearly half its length; between the median nervules near their origin are two whitish spots.

Hab. Cameroons.

Allied to *E. elion*, Doubl. & Hew.

This beautiful species is one of the largest of the Lycænidæ.

Epitola Dewitzi.

Expands from $1\frac{3}{4}$ to nearly 2 inches.

Male.—Fore wings triangular; costa arched at the base, tip projected; hind margin slightly emarginate about the middle and sloped gradually to the anal angle. Hind wings rounded, curved outwards; anal angle very slightly rounded off. Fore wings black, with a deep blue band extending from the base between the median and submedian nervures nearly to the extremity of the wing, and a curved row of four blue spots above it, two at the end of the cell and two linear between these and the larger blue space. Hind wings deep blue, the costa and inner margin broadly and the hind margin narrowly bordered with black. Underside: fore wings brown, with two longitudinal spots at the end of the cell, and an irregular curved row of white spots near the hind margin; underside yellowish brown, with a broad white subcostal band; a curved white band running from the base of the inner margin round nearly to the tip, and an oval white spot between.

Female.—Wings longer, fore wings with the hind margin oblique, hardly emarginate; the markings similar, but the

blue colour paler; two bluish-white spots at the end of the cell, and an obsolete row of pale bluish spots curving beyond the cell from the end of the main blue stripe to the costa. Hind wings with a uniformly broad blackish-brown border. Underside: fore wings nearly as in the male, but tinged with yellowish grey towards the tip, and narrowly along the costa: hind wings yellowish grey, shading into light brownish in the cell.

Hab. Cameroons.

Closely allied to *E. ceraunia*, Hew., from which the under surface of the male hardly differs.

Epitola dunia.

Expands $1\frac{1}{2}$ inch.

Male.—Wings broad; fore wings with the costa arched, the hind margin nearly straight; hind wings moderately rounded, anal angle only slightly rounded off. Fore wings black, with a large purplish-blue patch on the inner margin at one fourth of its length, ceasing before the anal angle, and continued upwards into the cell; the base of the cell and inner margin is slightly dusted with blue: hind wings purplish blue, the costa above the cell and the inner margin black, the hind margin more narrowly; the upper part of the discocellular marked with black. Underside light brown: fore wings with a large space on the outer half of the inner margin whitish: hind wings with scattered white scales, having a tendency to run into rows.

Hab. Cameroons.

Allied to *E. cercene*, Hew., but less blue above, and with no distinct markings on the underside.

Epitola marginata.

Expands $1\frac{1}{2}$ inch.

Male.—Wings with the fringes denticulated; fore wings broad, hind margin rounded off towards the anal angle; hind wings rather short, the hind margin gradually rounded; fore wings blue, broadly black at the base of the cell, above the cell, and at the tip and hind margin, nearly to the anal angle, and the discocellular also marked with black: hind wings blue, the costa above the cell, the hind margin narrowly, and the inner margin moderately bordered with black; the incisions on all the wings dusted with white: hind wings brown, dusted with white, in such a manner as to form irregular obsolete zigzag lines and blotches, especially towards

the inner margin of the fore wings and the hind margin of the hind wings.

Hab. Cameroons.

Allied to *E. dunia.*

Epitola versicolor.

Expands from $1\frac{1}{4}$ to over $1\frac{1}{2}$ inch.

Male.—Fore wings rather short and broad, hind margin nearly straight, slightly rounded above the anal angle; hind wings moderately rounded: fore wings brown, darkest on the hind margin, pale blue at the base in the cell and below; the discocellular is conspicuously black; beyond the cell is a broad, curved, white band, narrowing from the inner margin nearly to the costa, before which it ceases: hind wings brown, pale blue in the cell and below; hind margin shading into darker brown. Under surface light brown, with numerous traces of irregular transverse pale lines; the white transverse band in the middle of the fore wings as above, except that it is of a more yellowish white beyond the cell and towards the costa.

Female similar, but larger and paler. Fore wings with the white band not extending to the inner margin: hind wings uniform pale brown. The underside is of a light greyish brown, with no yellow shade in the white band; the discocellular is nearly surrounded with white, and there are a few other indistinct whitish markings.

Hab. Cameroons.

An aberrant species of the *E. cercene* group.

Epitola badia.

Expands $1\frac{1}{4}$ inch.

Male.—Wings short, moderately broad; hind margin of fore wings gradually curved; wings blue, fore wings with the costa above the cell and the tip and hind margin black, narrowing to the anal angle; no mark on the discocellular, but the median nervure with a thick blackish streak at the base: hind wings with the costa above the cell, the inner margin, and the upper part of the hind margin with a moderately broad black border; the lower part of the hind margin narrowly edged with black. Underside greyish brown, paler on the inner margin of the fore wings, and with very slight traces of obsolete zigzag markings.

Hab. Cameroons.

Allied to *E. zelza*, Hew.

Epitola uniformis.

Expands about $1\frac{1}{4}$ inch.

Shape of *E. badia*, which it much resembles; the blue is paler, especially in the female, in which sex the brown border of the hind wings is much broader; there is a conspicuous blackish spot at the end of the cell of the fore wings, which at once distinguishes it. Underside uniform brown, greyer and with a pale space on the inner margin of the fore wings in the female.

Hab. Lagos (♂), Cameroons (♀).

Allied to *E. zelza*, Hew., and *E. badia*.

LVIII.—*Description of the hitherto unknown Male of* Ornithoptera Victoriæ, *Gray*. By H. Grose Smith.

Ornithoptera Victoriæ, Gray.

Male.—Upperside. Anterior wings velvety black, the basal three fourths of the cell and two thirds of the space beneath the cell to the inner margin golden green. Towards the apex is another large patch of golden green, triangular, the base of the triangle being just below the first discocellular nervule; between the basal and apical patches of colour is a brownish-black sericeous space.

Posterior wings velvety black, the space between the costa and the cell, the basal part of the cell, and the basal part of the median nervules green; three submarginal oval golden-green spots between the nervules, the first being situate below the second subcostal nervule, and each of the lower spots being centred with a bright orange ovate spot; the rest of the wings, except the fold, more or less irrorated with green; the abdominal fold only extends two thirds the length of the wings, causing the appearance of an excavation at the anal angle. Both wings are comparatively narrow, the cell on the upper wings is very broad, and on the lower wings is elongated.

Underside. Both wings golden green. Anterior wings, costa, and nervures black; an irregular black patch towards the upper part of the end of the cell and beyond it, with a few scattered green scales, and four submarginal lunular black spots between the nervules; the space above the inner margin, almost as far as the cell, devoid of scales and brownish grey. Posterior wings with elongated or ovate black spots

at the ends of the nervures, and two orange spots near the margin, as on the upperside; anterior margin and nervures narrowly black. Head, thorax, and antennæ black. Abdomen ochraceous, a row of spots on each side. Expanse of wings $6\frac{1}{8}$ inches.

Two males of this extraordinary and gorgeous insect have recently been sent to England by Mr. Woodford, who captured them in the island of Malayta, one of the Salomon Islands, with several females, flying at the tops of trees, where he was obliged to shoot them. A specimen of the female has been in the British Museum for upwards of thirty years and is described and the upperside figured in the 'Proceedings of the Zoological Society,' 1856.

In the collection of Mr. H. Grose Smith.

LIX.—*Characters of undescribed Coleoptera in the British Museum.* By Charles O. Waterhouse.

Pectinicornia.

Lucanidæ.

Odontolabis femoralis, n. sp.

♂. Black, with pitchy tint on the middle of the head and thorax. The elytra yellow, with the extreme base, the suture, and the margins narrowly bordered with black; under margin black. Mentum pitchy. Metasternum with a large patch of yellowish red on each side. Femora and tibiæ almost entirely yellowish red, the anterior tibiæ darker. Mentum hairless.

Length 22 lines, mandib. 3 lines.

♀. Black; elytra yellow, with a triangle of black common to both elytra; the margins narrowly bordered with black. Metasternum with a red spot on each side. Femora almost entirely red; tibiæ pitchy.

Length 20 lines.

The male of this species resembles *O. gazella*, Fabr. (*bicolor* of many authors); but, besides the red colouring of the underside, it differs in having the mandibles straighter, less flat, and less rugose. The head is shorter and broader. The thorax is rather flatter and more parallel, *i. e.* the lateral angle is not so prominent. The anterior tibiæ have two small teeth on the posterior edge; the other tibiæ are unarmed.

The female is much flatter than that of *O. gazella*, the thorax parallel at the middle of the sides, the lateral angle projecting only slightly. The black triangular patch, common to both elytra, extends a little over the humeral angles, narrowing rapidly posteriorly to a point at the apex. In the colour of the elytra it is more like *O. cuvera*, but the black is broader at the base and narrower at the apex.

This species should be placed next to *O. gazella*.

Hab. Perak (*L. Wray, Esq.*).

Serricornia.

Buprestidæ.

Amyia punctipennis, n. sp.

Obscure cyanescens, nitida; elytris creberrime sat fortiter punctatis, purpureo-cupreis, minus nitidis.

Long. 9 millim.

Much narrower than *A. chryselytra*, and somewhat resembling *Eumerophilus* in general form. Head rather strongly punctured, longitudinally impressed in front; with a slight swelling on each side of the upper part of the forehead, and two very slight obtuse tubercles on the lower part of the face. Thorax a little broader than long; very gently arcuate at the sides; the punctuation sparse and obscure. The disk is slightly transversely impressed in front (leaving the anterior margin somewhat raised); longitudinally rather deeply impressed behind. Scutellum æneous. Elytra subparallel for two thirds their length and then narrowed to the apex, declivous at the apex; with a large shallow impression at the base between the shoulder and the scutellum; closely and rather strongly punctured, the punctures generally elongate and having an asperate appearance. Prosternum densely punctured. Abdomen very delicately and moderately closely punctured; with a slight fovea on each side, indicating the division between the first and second segments.

Hab. Parana.

Amyia cribrata, n. sp.

Chalybea, fortiter punctata; elytris æneo-auratis, basi vage cuprascentibus.

Long. 10 millim.

Somewhat similar in form to the preceding species, but more robust. Antennæ short, black. Head closely and very strongly punctured, gradually sloping down (not raised above the eyes), impressed above the clypeus. Thorax about one

fifth broader than long, *very* strongly and rather closely punctured; the sides slightly flexuous; somewhat suddenly narrowed at the anterior angles. Elytra evenly convex, declivous at the apex; *very* strongly and rather closely punctured; the punctures irregular in shape and rugose at the bottom. Prosternal process punctured in the middle. Abdomen with very short pale pubescence at the sides and apex of the segments.

Hab. Brazil?

Heteromera.

Eutelidæ.

Mechanetes, n. gen.

General appearance of *Diceroderes*. Mentum a little broader than long, gently emarginate in front, the angles much rounded, the sides slightly rounded; the base narrow. Ligula transverse, gently emarginate in front, with the angles rounded. Labial palpi short and thick, the apical joint a little longer than broad. Apical joint of the maxillary palpi large, about one third longer than broad, rather broader at the apex than at the base, slightly curved, truncate at the apex. Mandibles bifid at the apex. Labrum prominent, short and transverse, with the angles rounded. Epistome separated from the forehead by a not very distinct impressed line. Eyes transverse, narrow, lunulate. Antennæ moderately long, robust; the second joint very short and broad, third joint as long as the first and second together, the fourth joint a little more than half the length of the third, the fifth to eighth joints subequal; the ninth, tenth, and eleventh joints forming a distinct, oblong-ovate, compressed club; the divisions between the joints not very distinct. Thorax a little longer than broad, slightly narrowed at the base; with two long, thick, curved, acuminate, horizontal horns, one on each side of the anterior part of the disk, and projecting on each side of the head. Elytra at the base the same width as the base of the thorax, rather wider in the middle, embracing the abdomen (as in *Diceroderes*), flattened on the back, declivous at the apex, striate-punctate; each elytron with an obtuse undulating costa extending from the shoulder to the posterior declivity. Prosternal process curved down posteriorly; mesosternum oblique anteriorly. Metasternum very short. Intercoxal process of the abdomen broad ogival. Tarsi clothed beneath with moderately fine but not very dense hair. Anterior femora with a small but strong tooth on the

underside near the apex; the intermediate and posterior femora with a much smaller tooth. Epipleural fold of the elytra not very broad, narrowed to the apex.

This interesting genus must be placed next to *Diceroderes.*

Mechanetes cornutus, n. sp.

Niger, opacus; thorace minute granuloso; elytris fortiter striato-punctatis.

Long. 16 millim.

Head strongly and closely punctured. Thorax a very little longer than broad, with small conical projection at the sides behind the middle; anterior angles effaced; disk with a slight central impression. Scutellum small, triangular. Elytra at the base not broader than the base of the thorax, gradually wider to the middle and then narrowed to the apex; the surface extremely finely granular; with lines of strong punctures, the punctures separated from each other; the dorsal interstices flat. The undulating sublateral costa, when it reaches the posterior declivity, turns suddenly outwards, and is continued a very short distance on the next interstice. Legs thickly punctured.

Hab. Perak (*L. Wray, Esq.*).

Longicornia.

Lamiidæ.

Epicedia Wrayi.

Nigra, pube obscure fulva vestita; singulo elytro macula rotundata ante medium, altera parva sub humero, tertia majore triangulari laterali nigro-velutinis ornatis.

Long. 29 millim.

Somewhat similar to *E. maculatrix*, but relatively longer, especially in the elytra. The surface of the thorax is more uneven, the tubercles on the disk are more elevated; they are placed as follows:—one small one in front of the central impression (not a broad double one as in *maculatrix*); two on each side, subconfluent longitudinally; two posterior, placed side by side. In the middle of the base of each elytron there is a line of about eight small shining black tubercles, and there are several other similar tubercles about the shoulder. The spots on the elytra are similar to those in *E. maculatrix*, except the posterior lateral one, which is about half the size, narrowed, and hooked down on the disk.

Hab. Perak (*L. Wray, Esq.*).

LX.—*On the Caucasian Mountain-Goat* (Capra caucasica, *Güld.*). By H. Dinnik *.

[Plate XIV.]

There are three, according to some data four, kinds of wild goat in the Caucasus. One of these is easily distinguishable from all the rest by its flattened horns and their sharp anterior rib †. Many observers consider it, together with the domestic and Kashmirian goat (*Hircus Falconeri*, Kügel), a representative of a distinct species. This is the so-called Bezoar goat (*Hircus ægagrus*). Pallas first made of it a separate species, and named it *Ægoceros ægagrus* (*Capra ægagrus*, Gm.). Its horns bend backwards in a gradual curve and form more than a half-circle: at first they slightly diverge, but again approach one another towards the tips; the sharp front rib has a few large nodules, while that at the back is smoother; their outer and inner surfaces are wrinkled; the transverse section is oval, the longer diameter being twice as great as the shorter.

The Bezoar goat inhabits the Southern Caucasus, Armenia, Persia, the Taurus, and possibly the island of Crete. In the Kuban and Western Terek regions I not only did not meet with this goat, but did not even once see its horns, which are common in Transcaucasia. I therefore consider its chief habitat to be the mountains of the Southern Caucasus and the southern slope of the main chain ‡. Pallas considers it to be the parent of various kinds of domestic goats, and his view is confirmed by comparing their horns.

Other kinds of Caucasian goats have horns more or less

* Translated from vol. xiii. of the 'Works of the Society of Naturalists of St. Petersburg' by Delmar Morgan, F.R.G.S.

[The two Caucasian wild goats, *Capra caucasica* and *C. Pallasii* (which, as may be seen by the mounted and correctly named specimens in the gallery of the British Museum, are quite distinct), having been confounded together by Blasius, Gray, and other recent authorities, including myself (P. Z. S. 1886, p. 314), I think that the present translation, which gives much information on the subject, will be acceptable to those naturalists who cannot understand the original. I am indebted to Dr. Strauch, of the Imperial Museum of St. Petersburg, for a copy of the original, and to Mr. Delmar Morgan for his kindness in making the translation.—P. L. Sclater.]

† These horns have two raised surfaces, an outer and an inner, besides two ribs, one in front sharp, and one behind rounded.

‡ According to M. Radde, *Hircus ægagrus* is more frequently met with at the sources of the Argun than *Capra Pallasii* (Zapiskí Caucasus Section Geogr. Soc. fasc. xi. pt. 2, p. 251, 1881).

rounded (let it be understood we are speaking here of males, as the horns of females are not very characteristic). Their transverse section near the base is triangular or square, with rounded corners, and in some cases almost round. To this group belongs the goat inhabiting Mount Kazbek and its surrounding mountains. It was first described in 1841 by K. F. Rouiller under the name of *Ægoceros Pallasii* *, and was afterwards named by Schinz † *Capra Pallasii*, a name now generally accepted.

Rouiller has well remarked that *Ægoceros Pallasii* is a transitional form between the goat and the sheep. Its horns are almost triangular at the base, then round, and only flat towards the tips, while their twist is peculiar; they first grow upwards and outwards, then backwards and downwards, finally inwards and upwards, forming a spiral or screw characteristic of sheep's horns. Rouiller was therefore fully justified in describing this animal as a goat with sheep's horns. The surface of the horns is intersected by a number of wrinkles, and there are slight nodules in front. The muzzle of this goat is hooked, like a sheep's; its body is long; its tail long, like that of a sheep, round and hairy below; but the hoofs are relatively blunt. This species therefore has other points of resemblance to the sheep besides its horns. According to the reports of hunters it frequents less elevated mountains than goats in general.

A specimen of this goat was presented to the Moscow University by Yermolof about the year 1840, and Rouiller founded upon it his description; subsequently two skins of the same species were obtained for the Academy of Sciences by Reout, and there are now, to the best of my belief, three or four stuffed specimens in the museum of the Academy ‡.

Another species belonging to this group is *Capra caucasica* of Güldenstedt, or *Ægoceros ammon* of Pallas. This is a true goat, closely resembling the Alpine species (*Capra ibex*, Linn.). Though some zoologists confound it with *Capra Pallasii* §, yet the two are so distinct that it is positively impossible to identify them as one and the same animal.

* Rouiller, Bull. des Nat. de Moscou, 1841, p. 910.

† [This is not quite the case. Schinz's *Capra Pallasii* is merely a synonym of *C. sibirica*, Pallas. See his article in Neue Denkschr. d. allg. Schweiz. Gesellsch. ii. p. 3 (1838).—P. L. S.]

‡ Its horns may always be seen at the Kazbek station of the Georgian military road.

§ Blasius, in his work 'Naturgeschichte der Säugethiere,' is doubtless in error in regarding *Capra caucasica*, Güld., and *Ægoceros Pallasii*, Rouill., as synonyms. His drawing, with the inscription "*Capra caucasica*" (p. 479), represents *Ægoceros Pallasii*, Rouill., and very faithfully portrays the peculiarities of the horns of this animal.

The first notice of this goat is by Güldenstedt, published after his decease by Pallas in the 'Acta Academiæ Petropolitanæ.' No other naturalist has written upon it, so that to the present day it has remained almost unknown *. Not a single stuffed specimen of it is to be found in any collection; the museum of the Academy of Sciences only contained one pair of its horns until, at the request of M. A. A. Strauch, I supplied a second pair, while I sent a head in a somewhat damaged condition with horns to the St. Petersburg Society of Naturalists.

Capra caucasica, Güld., is a graceful, handsome, and very powerful animal. Its head is narrow and not large, the nose straight, ears narrow and long, eyes of medium size, without lachrymal ducts, neck short and very strong, body massive; feet comparatively thick, very hard, and furnished with hoofs admirably adapted for climbing. The fur is mixed with down. The general appearance of the animal impresses one with its strength and endurance. This goat is commonly called *jugutur* by the natives (Karachaieftsi) in whose country it is found, and by Russians *tur*.

A full-grown male has horns black or almost black in colour, set so close together at the base as almost to touch; their curve is regular, much less than half a circle, and inclined in one plane. In some cases, however, there is a slight deflection to one side. From the head the horns rise upwards and outwards, then backwards and outwards, and finally downwards. Their tips do not approach one another or only slightly; their distance apart is therefore great. In one skull in my collection this distance is nearly 3 feet, while the average-sized horns of *Capra Pallasii* also in my collection are only 11 inches apart at the tips. The transverse section at the base of the horn is triangular, with very blunted corners, and therefore more or less circular. The circumference of the horns at the base is in the case of old males 11 to 12 inches, the diameter about $3\frac{1}{2}$ inches or a little over; the length along the anterior surface is from 23 to 32 inches. It is very probable that there are specimens with larger horns. The exterior of the horn is intersected with numerous transverse wrinkles or furrows in irregular rings, zigzag fashion. On the front surface there are small but more or less conspicuous nodules. The substance of the horn is invariably black, while its surface takes a variety of shades of black, brown, and dirty green. The horns of the females are so small as hardly to exceed the length of the ears; they

* Pallas says in his 'Zoographia' (p. 229) very little about it. A more complete description will be found in Acta Acad. Petr. iii. pp. 273–281.

diverge slightly and bend backwards, and are flat at the sides; the rib formed by the intersection of the outer and inner surfaces is sharper than the others. The back surface is rounded: at the base are more or less deep wrinkles encircling the horn; towards the tip these become less and less marked, and at length disappear altogether.

The colour of the fur of *Capra caucasica* is not uniform; quite young specimens have hair of an ashy grey over the whole body, only along the ridge of the spine and on the front of both pairs of extremities is there a dark stripe, while the groins, throat, and belly are almost white. The head of old specimens is covered with an ashy-grey or yellowish-grey fur, darker in front than at the sides. The membrane covering the iris is cinnamon-yellow or cinnamon-black in colour; the bare part of the nose is black, the lips covered with short hairs of a dirty grey colour. The fur on the head is long and forms a tuft. The male has no regular beard, but instead of it hairs $3\frac{1}{2}$ inches long—not pendent, however, but sloping backwards; the outside of the ear is reddish grey, and white inside; the whole body is covered with grey fur also, with a yellowish or brownish tinge. Along the front of the legs and the ridge of the spine there is a dark stripe, but this does not occur in all specimens. The fur on the belly is light, the tail covered only above with dark brown hairs; the hoofs almost black.

All the incisors of the lower jaw are about equal in size, thick, and round; their masticating-surface is also round, but much less concave than those of other ruminants (*e. g.* the antelope and reindeer). There are six molar teeth in the upper and lower jaws, increasing in size from first to last. The first four teeth of the upper jaw have almost a square masticating-surface, the fifth is somewhat elongated, and the sixth is twice as long as it is wide. Thick coats of enamel are only formed on the last tooth. In the lower jaw the first three teeth have nearly a square masticating-surface, and the length of the last of these is three times its width; the fifth tooth has one, and the sixth two thick coats of enamel. The young have fewer molar teeth. Thus, a two- or three-year-old male had only four teeth in the upper jaw on either side, and a fifth not fully developed was concealed in the bones of the jaw. The skull has the following peculiarities:—high forehead, strongly developed about the eyes; small occipital bones; on the scale of the temporal bone are big nodules to attach the powerful muscles of the neck necessary for raising a head furnished with such massive horns. The frontal suture entirely disappears in early life, and in old

animals the occipital is also hardly distinguishable; the coronal suture is likewise almost imperceptible in old specimens, and of the lambdoidal there is not a trace even in young animals. The other cranial and facial sutures have no peculiarity. The concavity of the eye is surrounded by a very strong, raised, continuous osseous ring. The nasal bones are wide and very thick. Between the lachrymal, nasal, and frontal bones there is a narrow foramen.

The hoof of this goat has the following peculiarities:— The underneath part or sole consists of a thick, firm, but tolerably soft and elastic skin; in movement this adjusts itself to all the unevennesses of the rocks and prevents the foot from slipping. On the sides and in front it is confined to a ring of very hard horny substance, which is thicker in front, and forms a reliable crook for grasping the slightest ledge or hollow. I have also observed in young goats a distinct projection on the back part of the sole, which prevents the foot from slipping forward; full-grown specimens do not always have this.

The distribution of every kind of *Capra* is very limited. We know, for instance, that the Alpine goat (*Capra ibex*) only inhabits the Swiss Alps and is not met with in the neighbouring mountains; the Pyrenees are inhabited by another kind, *C. pyrenaica*; the Sierra Nevada, and Sierra Ronda by a third, *C. hispanica* (Schimp.*); and so on. Possibly only one, *Capra sibirica*, Meyer, is an exception, by reason of its wide distribution; but if, as N. A. Sévertsoff suggests †, *Capra skyn* is to be distinguished from *C. sibirica* as a separate species, the regions of their distribution will be completely normal, *i. e.* limited like that of other species. Nobody has yet, I believe, discussed the distribution of each of the Caucasian goats: Güldenstedt pointed out the distribution of his *Capra caucasica*, but he did not know of the existence in the Caucasus of other forms of goats (*Capra Pallasii* was discovered much more recently); hence probably he fell into error in saying that *Capra caucasica* occurs on the Ossète road and in Kakhétia; but I have succeeded in learning something concerning the question.

I have several times been in the mountains at the sources of the Great and Lesser Laba, Urup, Zelenchuk, Teberda, Dóút, Kuban, on Elbruz and its spurs, everywhere I have hunted and examined the horns preserved by the hunters, yet never have I seen either *Capra Pallasii* (*Ægoceros Pallasii*, Rouill.) itself or its horns. Thus I may say with certainty,

* 'Blasius, Säugethiere Deutschlands,' p. 480.

† 'Vertical and Horizontal Distribution of the Turkestan Fauna.'

that to the west of Elbruz, therefore, throughout the Kuban mountains, this species never occurs; but here lives *Capra caucasica*, Güld. On the other hand, in the mountains at the sources of the Terek, Ardon, and on Kazbek I never saw *Capra caucasica*, but only *Capra Pallasii.* That *Capra caucasica* never inhabits this region I became convinced from the following circumstance:—

In 1879, while travelling on the Upper Ardon, I decided on visiting the Tsehya glacier, whence issues the Tsehya rivulet, a left tributary of the Ardon. [The author then proceeds to describe his coming across a pile of votive offerings on one of the passes, brought by the inhabitants to propitiate their deity, and containing a large number of goats' horns, which on examination proved all to belong to *Capra Pallasii*, and not a single one among several hundred to *Capra caucasica*, Güld.*]

The third species, *Hircus œgagrus*, is rarely met with on the northern slope of the principal Caucasus range, in the mountains of Kuban never. Neither did I see it in the Terek region; it is said, however, that it inhabits the eastern part of the Terek region. As to Daghestan I cannot be positive, for my own observations have not extended to that country.

C. caucasica invariably selects for its habitat places remote from human dwellings. On the mountains surrounding Great Karachai, rising to eleven and a half thousand feet above sea-level, it does not exist, owing to the proximity of inhabited places. The same may be said of the ranges on either side of the Teberdintsi encampments; there, in two places (Hida and Hutu), they are sufficiently numerous, but at some distance from human habitations. The case is quite different in the mountains at the sources of the Zelenchuk, Urup, and Laba, where, for 100 miles, there is literally no population, and which are visited only in the summer by the mountaineer shepherds with their flocks. Though the shepherds are nearly all hunters, the summer is so short that they cannot obtain many of the animals; hence, even at the present day, the wild goat abounds in these parts. All kinds of game, however, are plentiful here; while travelling in the summer of 1878, I saw almost daily bears, reindeer, and dozens of deer and goats. Though Elbruz is not so remote from inhabited parts, yet it possesses on its slopes endless labyrinths of

* The author's own observations led him to conclude that the limits of the distribution of both kinds are defined by the high spur of the main range on which stand two of the loftiest summits of the Caucasus—Dykh-tau and Kashtan-tau. East of this range is *Capra Pallasii*, Rouill., and west of it *Capra caucasica*, Güld.

rocks and precipices never yet trodden by the foot of man, and also abounds in wild goats. One day, the 29th June 1874, I saw three herds—one of 23, another of 15, and a third of 33 or 34 head; thus upwards of 70 head in a single day.

In completely uninhabited places the habits of the goat are distinguished by a few more or less important peculiarities. In such localities they keep in comparatively low parts, frequently where there are absolutely no snow-fields or glaciers, neither do they avoid the forests; they may therefore often be seen on the upper limit of the tree-zone between isolated peaks. At night they doubtless descend much lower; besides which, they are not so watchful, passing the greater part of the day quietly asleep, and may at such times be approached to within 200 paces on open ground. But in inhabited localities the contrary is the case. Here, during the day, they climb to an enormous height, and lie under projecting crags on the glacier or snow-field, preferring such places whence danger is visible afar off. They are even rarely met with on the lower part of the glacier, probably because they find it not elevated enough, and therefore insecure; but they may be seen on snow-fields 1000 feet above the snow-line. At about that height I saw two large herds in 1874 on the western slope of Elbruz. The ridge on which they happened to be was covered with snow with here and there a protruding crag devoid of all vegetation.

The wild goat is thoroughly gregarious in its habits. I have seen herds of 4, 8, 15, and upwards of 30, and an experienced hunter assured me that during winter he had seen upwards of 100 in a herd. Old males sometimes live apart, but mostly associate with the rest. Thus, at the sources of the Dóút, I have seen a herd of 8 goats, and among them three or four with huge horns; and in a large herd seen on Elbruz there were ten old males. Females with young only pass the first few days after parturition in seclusion; afterwards they join the herd, and assort with females and males. The young animals of one and a half or two years old either keep company with the old, or form small distinct coteries.

These goats generally pass their day thus:—Before evening they assemble on the lower ground in search of better and richer pasturage. In those places where they are but little molested, this movement begins about 4 or 5 o'clock in the afternoon in summer by their rapidly crossing the snow-fields and bare detritus, only occasionally stopping to assure themselves of their safety and to scent the air; they will also be attracted for awhile by a good patch of herbage. At such

times it is a beautiful sight to see an old male with enormous horns mount to some pinnacle of rock, and take a survey over the surrounding hills. The night is passed in the upper valleys near the forests, when the animals are exclusively engaged in feeding; but at the first streaks of dawn they renew their ascent of the cliffs. During the daytime they hardly feed at all, but are more usually seen reposing on the glacier, on snow or bare rocks entirely devoid of vegetation, some standing, others lying at full length, chewing the cud, while a few are asleep.

There is hardly any animal that can surpass the wild goat in climbing the most formidable parts of the mountains. It seems that only the loftiest precipices are inaccessible to it. An old native hunter once compared it with the eagle, by which he evidently meant that the wild goat can, by means of its feet, ascend many of those crags to which the eagle soars on wing.

The voice of the Caucasian Mountain-Goat resembles the whistle of the deer, though more prolonged. The animal utters it when alarmed, or, if danger be near, sometimes to warn its companions of the presence of an aggressor. It also bleats like the domestic goat, but louder, to express anger or alarm. Its senses of seeing and hearing are remarkably well developed, while its powers of scent are extraordinary. The hunter must stalk it from the leeward side, for any attempt to approach from the windward is at once detected, and the wary animal is off in an instant. Of course the pure fresh mountain air is greatly in the animal's favour. In point of intelligence this goat, like all its congeners, stands relatively high. The natives rank it with man, and I have myself observed how deliberately it acts at critical moments. Thus, if fired at, it will not run at haphazard, but first tries to discover whence the danger proceeds. It also defends itself with much skill from an aggressor.

Before the approach of winter, these goats are compelled by the deep snows to abandon the mountain summits and remove to lower places, where they are met with in autumn near the border of the forests, and in winter still lower at the bottom of the valleys. It must, however, be remarked that goats never descend so low as the antelopes, for instance, which are met with in winter in the lower belt of forests two and a half or three thousand feet above sea-level. In winter the goats feed on the foliage of various plants, and probably chiefly on lichens, which cover in large quantities the trunks and branches of the forest trees; in summer they eat various alpine plants.

On the 28th June I saw a large herd of these goats on Elbruz, comprising several females with young, and examined them closely through a telescope. The kids were apparently three weeks old. On another occasion I saw a young goat, apparently six weeks old, in the middle of July. From these data it may be inferred that the season of parturition is about the beginning of June or towards the end of May, *i. e.* a little earlier than that of the alpine goat (*Capra ibex*, Linn.). The period of pairing, according to the hunters, takes place in winter*, or, allowing five months for gestation, at the beginning of January; at such times it is said the males fight furiously.

A male kid which I had occasion to examine closely stood a foot and a half high, and was distinguished by the following peculiarities:—Nearly the whole of its body was covered with a uniform ashy grey fur; along the ridge of the spine and anterior of forearms there was a dark stripe, the belly and groins being nearly white. The head was most remarkable; in front of the ears it was curved almost to deformity, of course to allow room for the enormous horns which had to grow, the only signs of them as yet being two black glistening buttons about the size of nuts. The black hoofs were much flattened at the sides, and were furnished with false soles both in front and behind.

The mountaineers, who sometimes capture these kids, assert that it is only possible to catch them a few hours after birth, for the second or third day the kid runs and jumps so nimbly that a man is no match for it on the rocks. Before the kid is able to run, the mother in case of danger retires to the most inaccessible parts of the mountain, leaving her offspring to hide itself in some fissure between the rocks, where it will sit motionless. Its grey colour resembles so closely that of the stones as to make the kid invisible even three or four paces off. Only for the first few days after birth the she-goat goes alone with her young, afterwards she rejoins the herd and associates with the others. I have watched through a telescope the process of feeding the kid: it pulls at the mother's teats every minute, but only sucks for a few seconds at a time.

The chase after these goats, notwithstanding its extraordinary difficulties and perils, is the favourite amusement of the mountaineers †, and is chiefly indulged in by those shepherds

* In very rare instances the she-goat bears two at a birth, but this may only happen once in a hundred times. There are two teats on the udder.

† I have already written on the chase of the Wild Goat in 'Nature and Sport,' my articles being entitled "The Mountains and Ravines of the North-western Caucasus," 1879, fasc. 1, and "Elbruz," 1880, fasc. vi.

who pasture their flocks at the foot of the main range or its highest spurs. Hardly a day passes without their climbing the crags and glaciers in pursuit of antelope or goats, and they either stalk these up wind, or post themselves in the evening on some lofty eminence, where they await their quarry on its way back from the alpine meadows to the upper regions of the mountains.

The early autumn is the best time for killing these goats, when agricultural work is over, and the animals begin to descend, and are in the best condition. Goats, like all ruminants, are fond of salt; the hunters, aware of this, construct hiding-places near the saline springs, and there shoot these and other animals when they come to drink the salt water or lick the salt. At the sources of the Dóút, I observed that goats readily ate a fine clay powder which settles on the banks of this stream as it issues from the glacier. This powder is nothing but the product of disintegrated felspathic rocks, and contains neither common nor other salts soluble in water; yet it is devoured by antelope and goats in such large quantities as to impart a peculiar colour to their excrements.

Happily for hunters and naturalists, the wild goat is still so numerous in the Caucasus, that there cannot be any question of its extinction at present. I will again remind the reader that at the sources of the Urup and Laba our party saw every day herds of 10 or 15 head, while on Elbruz I myself saw three herds in one day numbering altogether 70 head*.

[The author here relates his own experiences in hunting the wild goat, and speaks of various attempts made to domesticate it.] The last time I had occasion to visit the mountains and observe the goats, I convinced myself that to the west of Dykh-tau and Kashtan-tau *Capra Pallasii*, Rouill., is never met with. The limits of its distribution begin to the east of these mountains, *i. e.* at the sources of the Cherek and Urukha. It is most probable that that lofty spur of the main chain of the Caucasus, on which rise the highest peaks, Dykh-tau and Kashtan-tau †, is the border-line dividing the range of the two species. From this point *C. Pallasii* extends across the sources of the Cherek, Urukh, Ardon, Terek, and as far as the Argun, perhaps beyond. At the sources of the last-named river, *C. Pallasii* and also *Hircus ægagrus* (*Ægo-*

* The celebrated hunter Akhiya, who served as guide to the Englishmen in 1872, to the summit of Elbruz, and astonished them by his extraordinary powers of vision and climbing, states that he has killed over 2700 of these goats.

† This range is very lofty, its highest peak being 17,000 feet.

ceros ægagrus, Pall.) are met with; but, as Radde remarks, *H. ægagrus* is here by far the most numerous.

C. caucasica is met with first on the western slope of Dykh-tau and beyond, at the sources of the Chegem, Baksan, Malka, Kuban, Teberda, Marukh, Zelenchuk, Urup, Laba, and as far as the sources of the Bielaia; whether beyond this to the W., I cannot speak positively; but I think not, because the range here becomes so low as hardly to afford a suitable habitat for this animal.

In this way *Capra caucasica* frequents part of the western half of the main Caucasian chain for 200 miles in extent. My observations having been made throughout the whole of this region, I was able to detect some marked distinctions between those inhabiting its westernmost parts and the rest. Their horns are comparatively short, thick, with a more decided outward turn at the base, and with large nodules on the anterior side. Their section taken near the base proved them to be quadrangular with rounded corners, rather than triangular. The circumference at the base of the horn as compared with the length measured along the anterior surface is equal to half or a little more. The colour of the fur of this goat is also perceptibly lighter.

But the typical *Capra caucasica* has relatively long horns, fewer nodules, the section at the base is more of a triangle, and the circumference of the horn at the base is invariably less than one half its length. I had comparatively few opportunities of observing this short-horned goat, and will therefore not venture to express an opinion as to whether it should be considered an independent species or a variety. Judging from its horns it is closely allied to the typical *C. caucasica* and therefore cannot be considered a distinct species.

While travelling between Elbruz and Dykh-tau, *i. e.* in the eastern half of this region, and examining the horns of the goats preserved there by the hunters, I observed this peculiarity, that their tips were much closer together, and in this respect resembled those of *C. Pallasii*. In every other respect they assimilate with *C. caucasica*, and, judging from a specimen killed, have no distinguishing peculiarities.

Thus the mountains of the Caucasus, with their luxuriant alpine pasturage, innumerable labyrinths of crags, with their glaciers and snow-fields, afford a home for several kinds of goats. Of these *Hircus ægagrus* keeps further south than the others, and is distinguished by its flattened, two-sided horns. *Capra Pallasii* is unquestionably the oldest type, and holds an intermediate place between goat and sheep. It inhabits the Central Caucasus. Probably from this and several

other transitional forms (e. g. *Hemitragus jemlaicus*) were derived the modern goats. *Capra caucasica* is quite a typical goat, having a close affinity with the Swiss species (*Capra ibex*, L.) and inhabits the Western Caucasus. Lastly, the goat with short thick horns inhabiting the westernmost parts may possibly form a fourth distinct species.

The horns of *Ægoceros Pallasii* figured in the accompaning Plate (fig. 2) are taken from a very good skull preserved at the museum of the Academy of Sciences. Those of *Capra caucasica* (fig. 1), from photographs taken by me, represent two forms —one a short-horned and the other a long-horned specimen.

LXI.—*Notes on the Osteology of the Genus* Platysternum. By G. A. Boulenger.

[Plates XVI. & XVII.]

The genus *Platysternum*, Gray, contains but one species, *P. megacephalum*, Gray, inhabiting Southern China, Siam, and Burma. Young specimens have been described by Gray as a distinct species, *P. peguense*. With the object of ascertaining the correct systematic position of this curious genus, of which the external characters only were known, I have had prepared a skeleton from a half-grown specimen (shell 10 centim. long), obtained in Southern China by J. Reeves. I have also been able to verify some points on an adult example, in spirit, from Laos, parts of which have recently been cut away by Professor Huxley with the object of examining the skull and the caudal vertebræ.

Carapace.—Although the specimen is only half-grown, the ossification of the carapace is perfect, with the only exception that the sutures between costal plates 2 to 4 and the corresponding marginals have not yet completely joined. It consists of a nuchal, eight neurals, eight costals, three pygals, and twenty-two marginals. The nuchal is nearly twice as broad as long, without costiform processes, its outline the same above and below. The first neural is slightly longer than broad, the second to seventh are subequal and broader than long, the eighth is very small and thrice as broad as long. The seventh pair of costals are in contact with the seventh and eighth neurals and the anterior pygal. The latter plate is trapezoid, much broader than long, a little longer and a little narrower than the second pygal, which forms likewise a

suture with the eighth costal. The marginals are subequal in length; the third to tenth pair have a median socket for the reception of the costal extremity; the third to seventh give attachment to the ligaments of the plastron. The second, third, and fourth ribs are joined to two vertebræ, the rest to one only. The tenth or last dorsal rib presents this peculiarity, that its extremity is connected, almost coalescent, with the preceding rib, an arrangement which presents the greatest similarity to that of the first and second dorsal ribs.

Plastron.—The union of the plastron with the carapace is by ligament, and remains so in specimens which have reached full size. Digitations on the outer border of the hyo- and hypoplastra, such as occur in *Chelydra*, in which the plastron is attached to the marginals by gomphosis, are absent, and *Platysternum* would therefore enter Cope's group Lysosterna. There are no fontanelles, and the plastron is altogether Emydian. The bridge is formed to a slightly greater extent by the hyoplastron than by the hypoplastron. The entoplastron is moderately large, its length about two thirds the greatest diameter of one of the epiplastra; its outer face is oval, broadest in front, its inner face more triangular, ending in a short acute process.

Skull.—The similarity of the skulls of *Platysternum* and *Macroclemmys* is very striking—same hooked jaws, lateral orbits, small frontals separated from the border of the orbits by the præ- and postfrontals, well-marked ectopterygoid processes, &c. The only important differences are that the orbits are larger and the tympanic cavity smaller, the greatest diameter of the latter being about half that of the former; that the supratemporal roof is still more developed, without, however, attaining the stage of the marine turtles, in which, as is well known, the parietal bones join the squamosals; and, lastly, that the jugal is completely enclosed between three bones, viz. the postfrontal, the maxillary, and the quadratojugal, an arrangement which does not occur in any other Chelonian. The hyoid apparatus is largely developed. The body consists of three ossified pieces, with a rhomboidal cartilaginous space between; there are two pairs of cornua, both ossified.

Cervical vertebræ.—The cervical vertebræ are in every respect those of a typical Emydoid, not of a Chelydroid *. The second and third are opisthocœlous, the fourth and eighth biconvex, the fifth and sixth procœlous, and the seventh biconcave; there are three ginglymoid articulations, v., vi., vii., as in *Emys orbicularis*.

Caudal vertebræ.—The three anterior are procœlous, the

* *Cf.* Vaillant, Ann. des Sci. Nat. sér. 6, x. art. 7 (1880).

next amphicœlous, then follow a series of nineteen opisthocœlous; the last ten are again procœlous.

Pelvis.—The pelvis, which is attached to strong sacral ribs, is intermediate between that of typical Emydoids, in which the pubis and ischium are in contact on the median line, limiting two obturator foramens, and that of *Chelydra*, in which the two bones diverge and are connected by ligament. In *Platysternum* the symphysial branches of the pubis and ischium are parallel, but yet connected only by ligament. I must remark here that the former type of pelvis, *i. e.* with two obturator foramens separated by the union on the median line of the symphysial branches of the pubis and ischium, occurs in all Testudinidæ (land and freshwater) which I have examined, with the single exception of *Dermatemys*, which belongs, in this respect, to the Chelydroid type; also in the Cinosternidæ, but not in the Staurotypidæ, which belong to the latter type.

The pectoral arch does not differ from that of *Emys*. The tarsus contains seven bones—two in the proximal row, five in the distal.

This investigation into the bony structure of *Platysternum* leads to the result that that genus can satisfactorily be placed neither with the Testudinidæ (incl. Emydidæ) nor with the Chelydridæ, which latter family may be characterized by the presence and great development of costiform processes of the nuchal plate, and the opisthocœlous nature of most of the caudal centra. It should therefore, in my opinion, rank as a distinct family, Platysternidæ, already established by Gray on different grounds, the position of which is between the Testudinidæ and the Chelydridæ.

EXPLANATION OF THE PLATES.

Plate XVI.

Carapace, upper and lower view. *c*, costal plates; *m*, marginals; *ne*, neurals; *nu*, nuchal; *py*, pygals.

Plate XVII.

A. Plastron, outer view. *enp*, entoplastron; *epp*, epiplastra; *hyop*, hyoplastra; *hypp*, hypoplastra; *xyp*, xyphiplastra.
B. Skull, upper view. $\frac{3}{2}$.
C. ,, lower view. $\frac{3}{2}$.
D. ,, side view. $\frac{3}{2}$.
E. Mandible, lower view. $\frac{3}{2}$.

bo, basioccipital; *bs*, basisphenoid; *exo*, exoccipital; *f*, frontal; *j*, jugal; *m*, maxillary; *p*, parietal; *pal*, palatine; *pm*, præmaxillary; *prf*, præfrontal; *pt*, pterygoid; *ptf*, postfrontal; *q*, quadrate; *qj*, quadratojugal; *so*, supraoccipital; *sq*, squamosal; *v*, vomer.

BIBLIOGRAPHICAL NOTICE.

The Larvæ of the British Butterflies and Moths. By the late WILLIAM BUCKLER. Edited by H. T. STAINTON. Vols I. and II. 8vo. London: Ray Society, 1886, 1887.

ALTHOUGH we have already many descriptions and figures of the larvæ and pupæ of the British Lepidoptera, we fancy that these volumes will be received with a hearty welcome by all students of the order. In fact a knowledge of the preparatory states of these insects is of so much consequence even to the mere collector, whose success in rearing larvæ, especially from the egg, depends entirely upon his knowing the species to which they belong and the proper food to offer them, that the series of figures, descriptions, and notes on habits, the publication of which has thus been commenced by the Ray Society, will appeal to a very large constituency.

Of the two volumes already published the first contains figures and histories of the larvæ of the British Butterflies; while in the second the Hawk-moths and twenty-seven species of Bombyces are treated in the same fashion. The third volume, to be brought out next year, will include the remainder of the last-named group.

The work, as explained by the editor in his preface to the first volume, is founded upon the labours of the late Mr. William Buckler, an artist and miniature painter of repute, who, after devoting some attention to entomology, was induced to undertake the illustration of the editor's great 'Natural History of the Tineina,' when the original artist gave up the work. From the year 1857, when he commenced his labours in figuring the Tineina and their transformations, Mr. Buckler seems to have turned his attention particularly to the larvæ of our indigenous Lepidoptera, and from that time until his death, in 1884, he was actively engaged in the study of their transformation, drawing up detailed notes upon their life-history and figuring them in the most careful manner. At intervals he published notices of his observations in the 'Entomologist's Monthly Magazine;' but these articles included only a portion of the results of his researches, and they were not accompanied by any figures, a great collection of which it was well known that the deceased entomologist had left behind him. These and four volumes of note-books were obtained from his executor by the Council of the Ray Society, who very justly thought it "highly desirable that the labours of half a lifetime should not be lost to science."

During his investigations of the preparatory states of the British Lepidoptera Mr. Buckler was in constant correspondence with the Rev. John Hellins, of Exeter, also an enthusiastic cultivator of the same field of research, who has now, we regret to say, followed his friend and coadjutor. Mr. Hellins also published many descriptions of Lepidopterous larvæ; and it appears that for many years it was the custom of each of them to send to the other for revision the MSS. of their respective papers, so that all their work may to a

certain extent be regarded as the result of their joint labours. In the present volume the same relation is preserved—the published contributions of both authors are reprinted, together with extracts from the MS. note-books above mentioned; while Mr. Hellins has supplemented the work of his friend with an appendix containing descriptions of those larvæ with regard to which nothing was written by Mr. Buckler, and with notes upon many of the other species. We have thus at the hands of these experienced and indefatigable workers a series of life-histories of the larger Lepidoptera of these islands of the most minute description, and we can only hope that the untimely decease of Mr. Hellins may not prove an obstacle in the way of the issue of the succeeding volumes.

Of the figures accompanying these descriptions, and which occupy thirty-five plates in the first two volumes, we can only say that in general they are very beautiful and life-like representations of the objects. In some cases, indeed, the colours, especially reds and greens, strike us as being rather too bright; but on the whole the figures leave little or nothing to be desired, and we can congratulate the student of British Lepidoptera on having furnished to him such a magnificent series of figures of the larvæ of nearly all his favourite insects. Of many species the caterpillars are figured at different ages, and occasionally the pupæ are illustrated.

A particularly valuable feature of the work is the addition of tables of the parasites which have been observed to issue from the larvæ and pupæ of the insects described in each volume. These tables have been furnished to the editor by Mr. G. C. Bignell, and it is to be hoped that their publication will induce others to take up a line of investigation which must lead to most interesting results.

MISCELLANEOUS.

Note on Tudicula inermis *&c.* By Edgar A. Smith.

There are three species at present described which belong to *Tudicula*, namely *T. armigera*, A. Adams, *T. spinosa*, H. & A. Adams, and *T. inermis*, Angas. All are from the shores of Australia. The first and second species have been found at various localities on the coast of Queensland. *T. spinosa* also occurs in Torres Straits. The other species inhabits the western side of the continent. Mr. Angas in describing this species observes that "the exact locality of the habitat could not be satisfactorily determined," as the specimens he had under examination were obtained from a dealer at Singapore.

The British Museum has recently acquired, through the liberality of Mr. T. H. Haynes, three specimens of this rare shell, collected by that gentleman at Exmouth Gulf, West Australia. Mr. Brazier, of Sydney, also informs me that he possesses examples of this species from Nicol Bay, somewhat further to the north-east of Exmouth

Gulf. The presence of this shell at Singapore is easily accounted for, as large numbers of shells are taken there from North-west Australia by the Trepang traders and those engaged in the pearl-fisheries on that coast.

The three species are perfectly distinct. Mr. Tryon's supposition * that *T. spinosa* is "probably identical with *T. armigera*," and that *T. inermis* (which should be of Angas, and not Sowerby) "is simply a depauperated specimen of the same species," is altogether incorrect. It is, however, a notorious fact that Mr. Tryon has made a large number of errors of this kind, and it is to be regretted that the usefulness of his work is in a great measure lessened through his rash judgment of the value of species which he has not had an opportunity of seeing personally.

All of the specimens of *T. inermis* received from Mr. Haynes have the canal fully six millimetres longer than that represented in Mr. Angas's woodcut †, and the colour is rather different. The general tone of the shell is lightish chestnut-brown, the angle of the body-whorl is spotted at intervals with white, a white band crossed by flames of a darker chestnut tint encircles the lower part of the body-whorl, and the aperture within, the columellar callus, and the thickened outer lip within and without are white.

The Natural-History Museum.

The Natural-History branch of the British Museum in Cromwell Road has just received a most important donation from Lord Walsingham, consisting of a collection of Lepidoptera with their larvæ, mainly British butterflies (Rhopalocera) and certain families of moths (Heterocera), including Sphingidæ, Bombyces, Pseudo-Bombyces, Noctuæ, Geometridæ, and Pyralidæ. There is also a fine series of Indian species, collected and preserved at Dharmsala, in the Punjab, by the Rev. John H. Hocking, and specimens of exotic silk-producing Bombyces, in various stages of their development, obtained mostly from Mons. Wailly.

With very few exceptions, the British larvæ, which retain a most life-like appearance and are placed upon models of the plants upon which they feed, have been prepared and mounted by Lord Walsingham himself—the process adopted having been inflation of the empty skin of the caterpillar by means of a glass tube and india-rubber spray-blower over a spirit-lamp guarded by wire gauze. This has been found a simpler and quicker process, and one admitting of more satisfactory manipulation than the alternative system of baking by means of heated metal plates or ovens. The specimens have mostly retained their natural colour; but in the case of the bright green species it has been found necessary to introduce a little artificial dry pigment. The whole collection consists of 2540 specimens of larvæ, belonging to 776 species, together with a series of the perfect insects of each species.

* Manual Conch. vol. iii. p. 144.
† Proc. Zool. Soc. 1876, p. 610.

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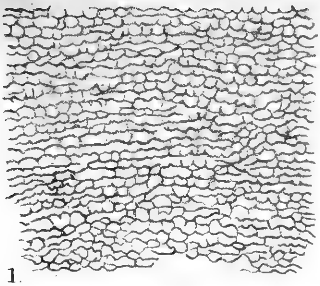
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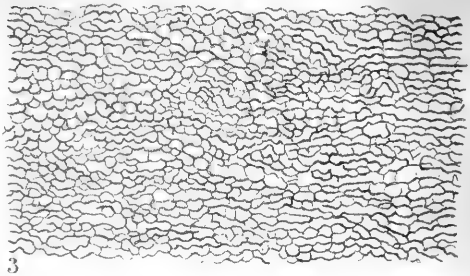
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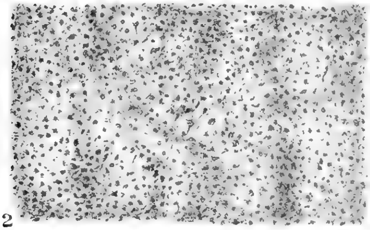
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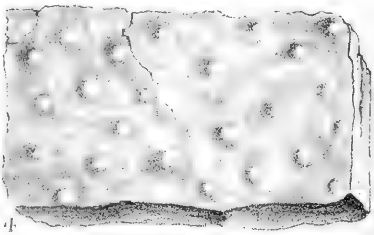
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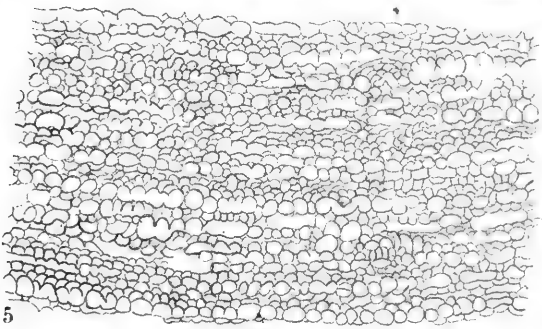
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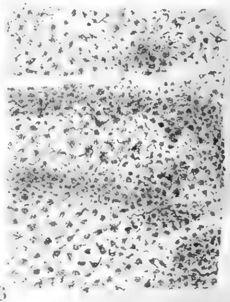
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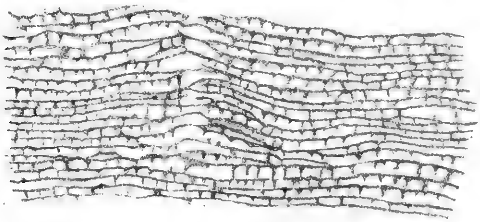
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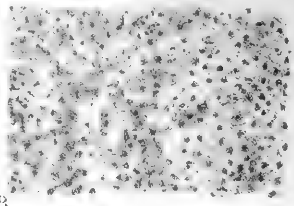
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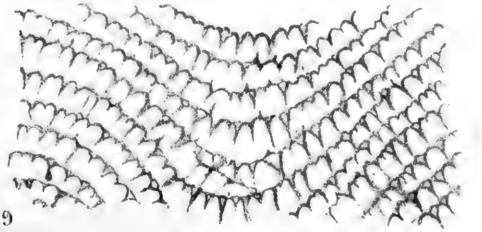
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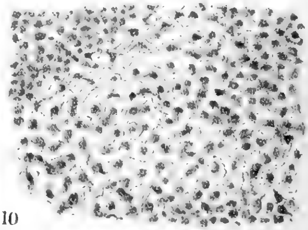
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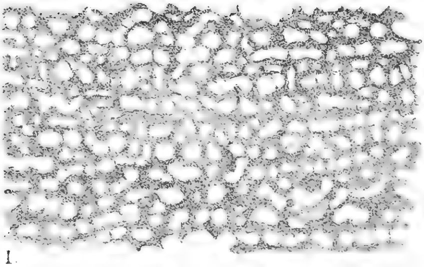
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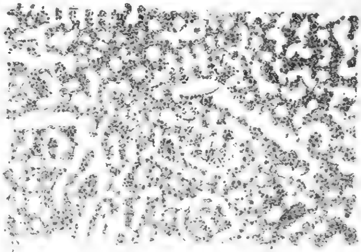

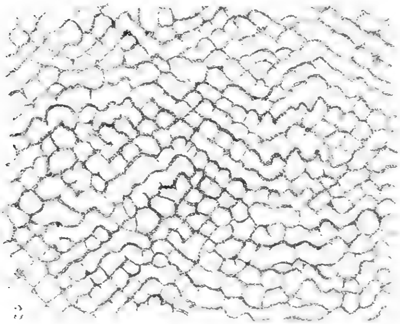
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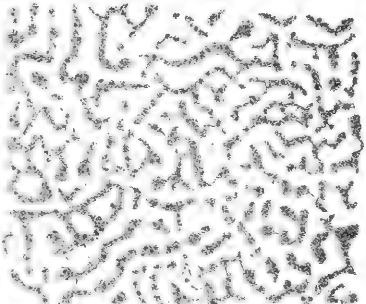
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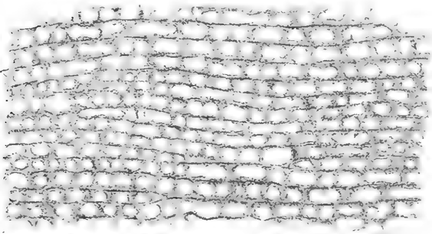
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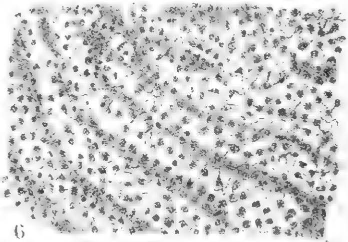
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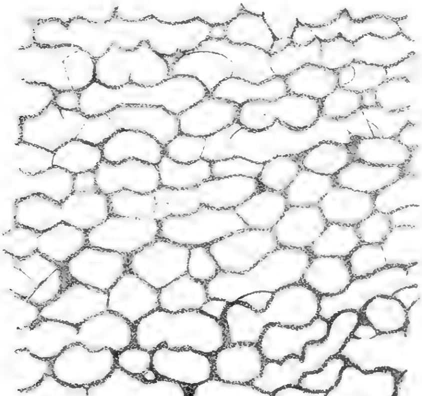
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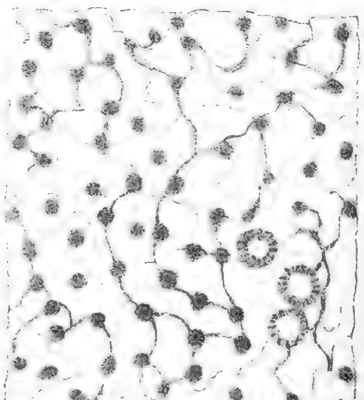
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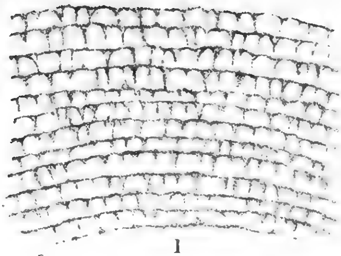

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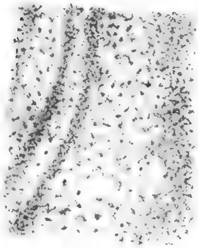

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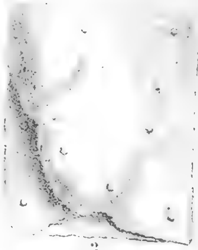

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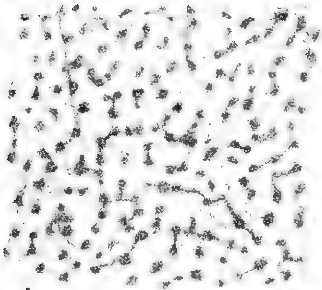

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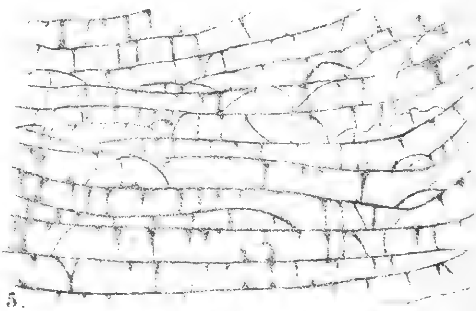

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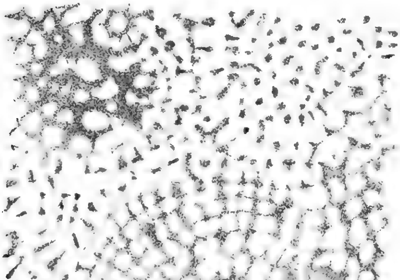

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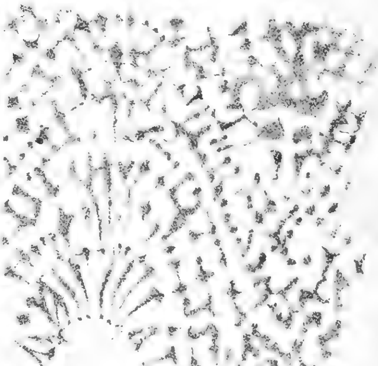

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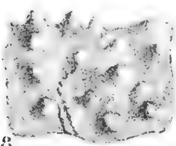

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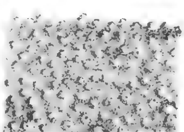

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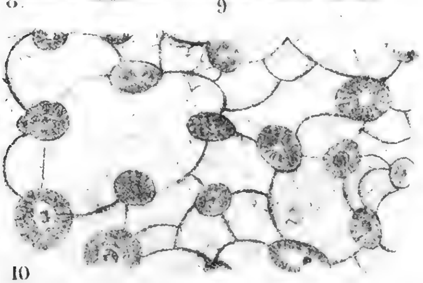

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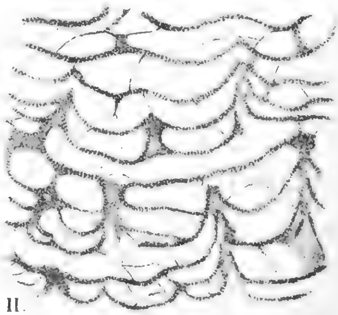
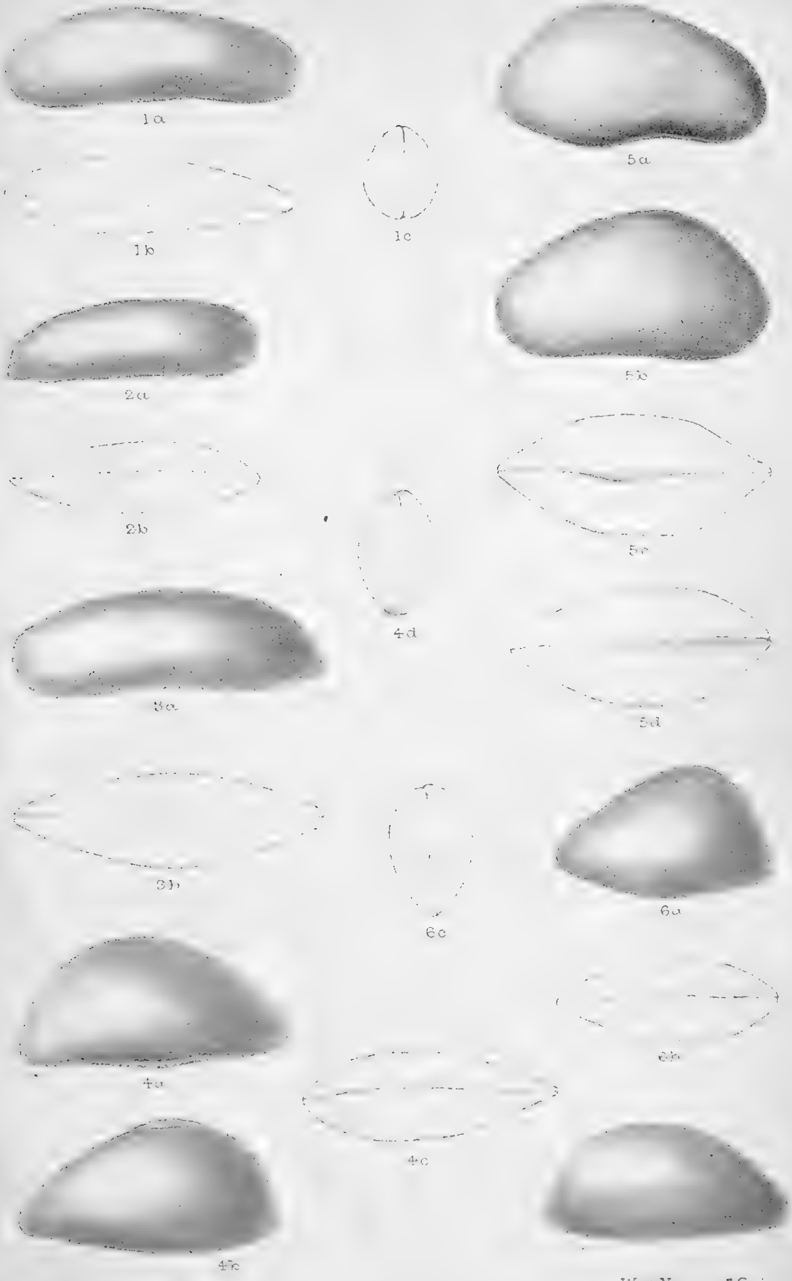


11.

H. A. Nicholson del. A. T. Hollick lith.

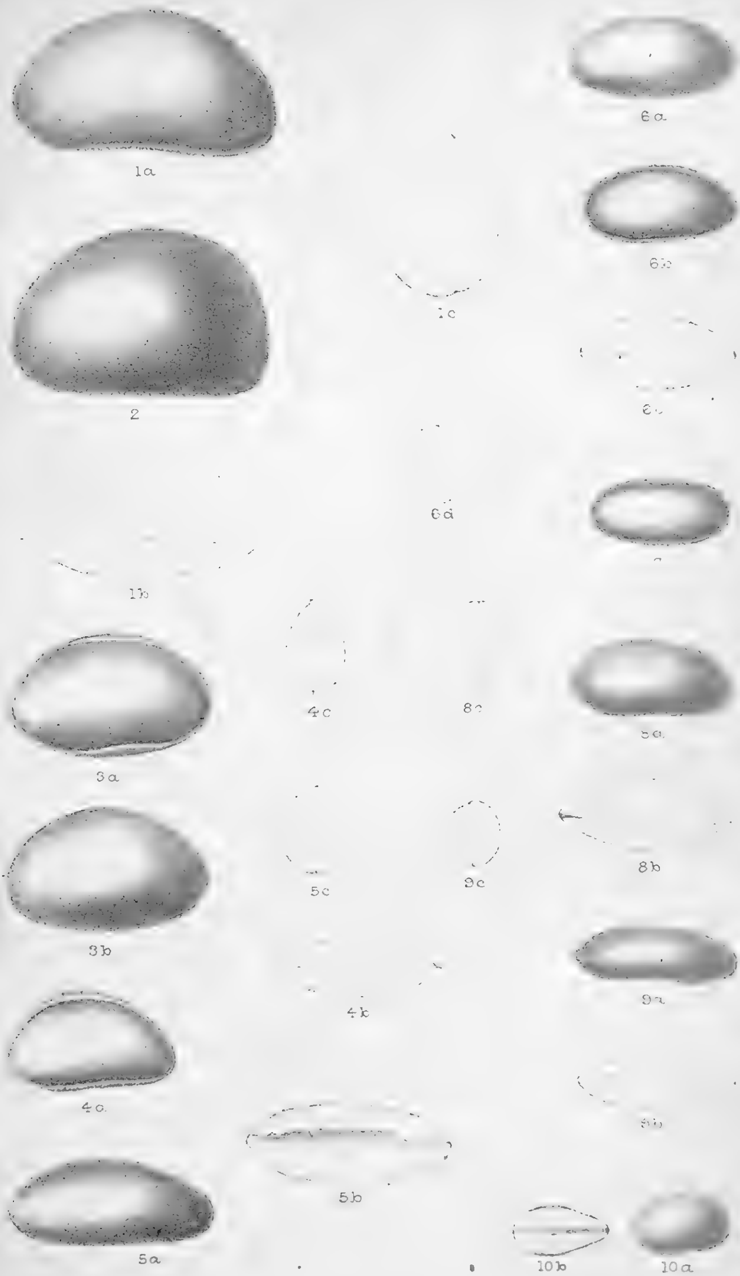
Mintern Bros. imp.



E.C.Knight lith.

West,Newman&Co.imp.

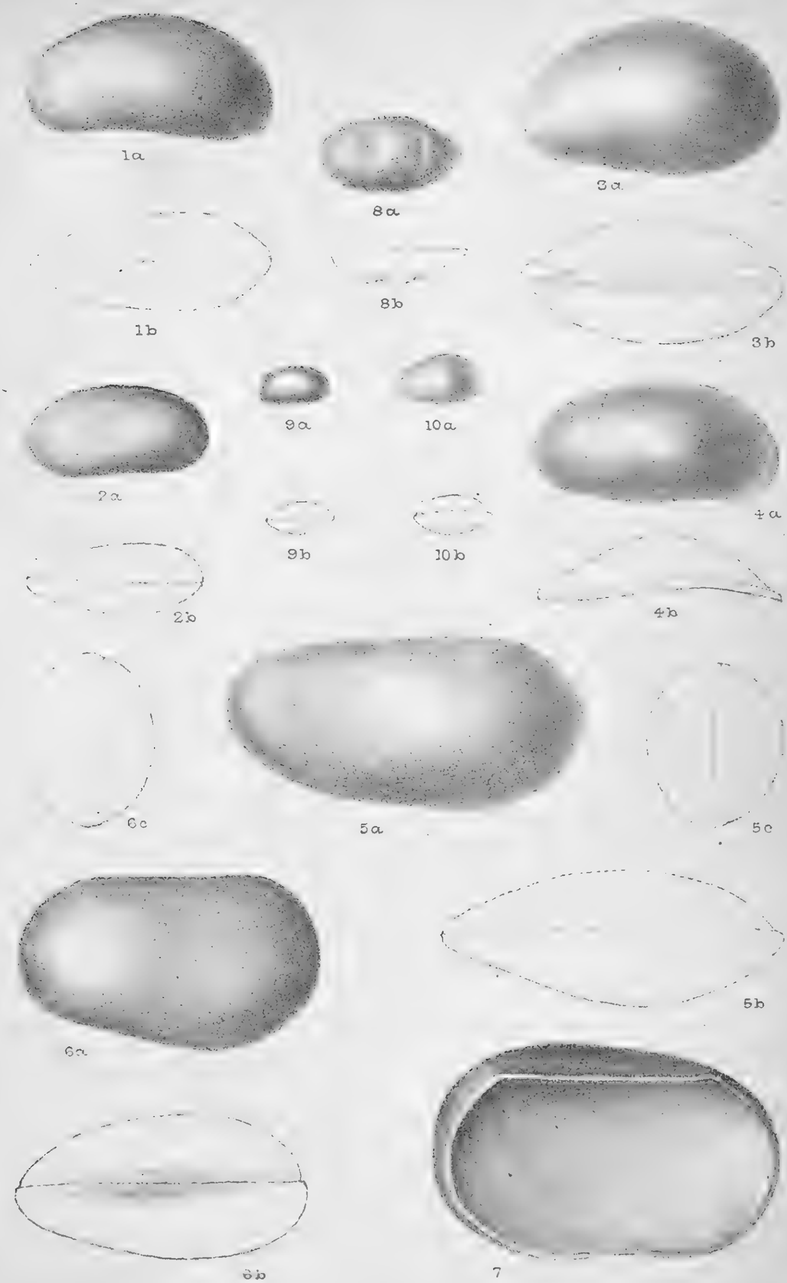
Silurian Ostracoda.



E. C. Knight lith.

West, Newman & Co. imp.

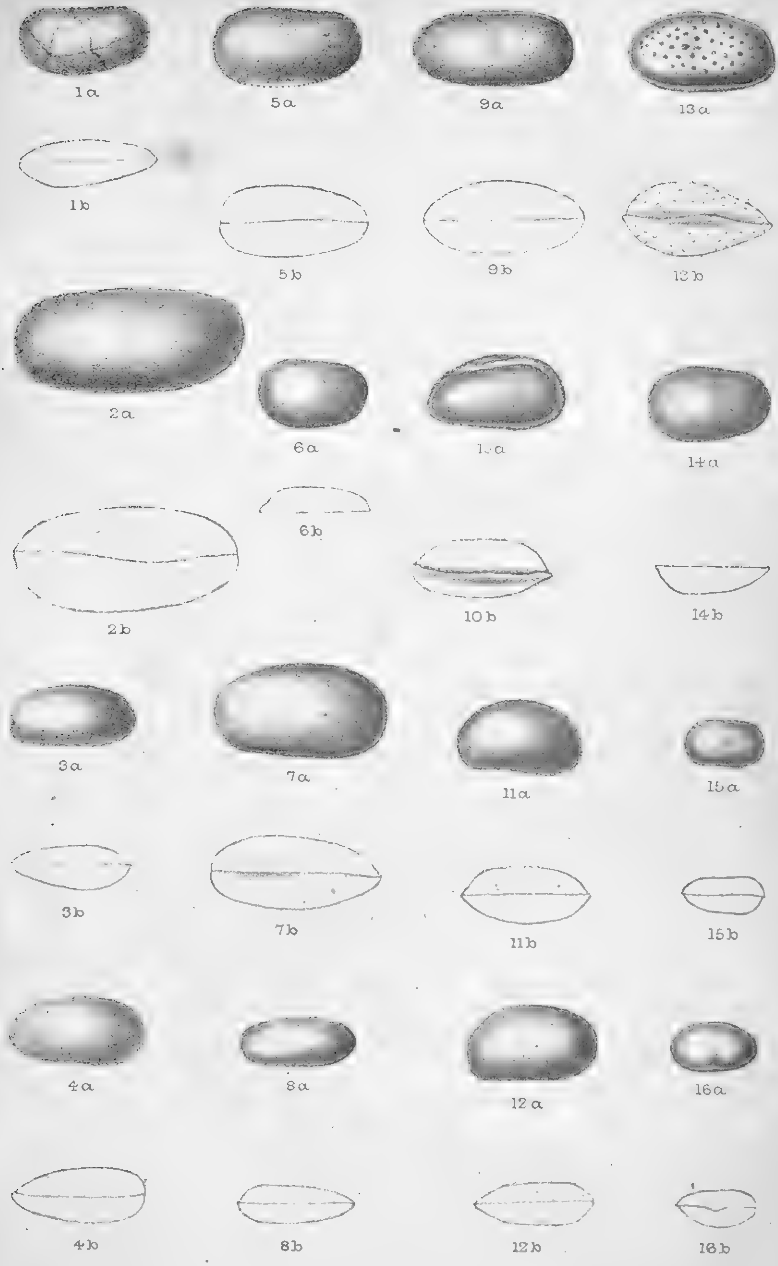
Silurian Ostracoda.



E C.Knight lith.

West,Newman&Co.imp.

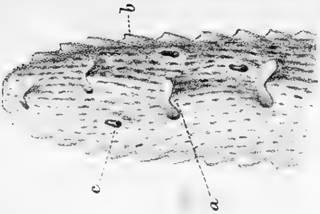
Silurian Ostracoda.



E.C.Knight lith

West,Newman&Co.imp.

Silurian Ostracoda.



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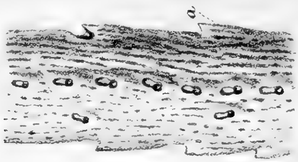

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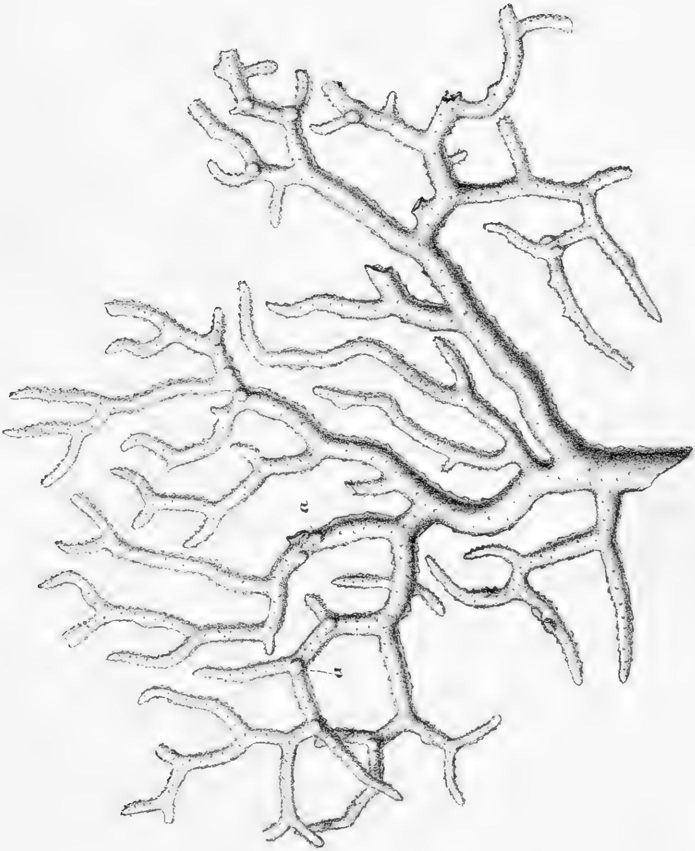
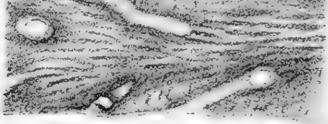


1.

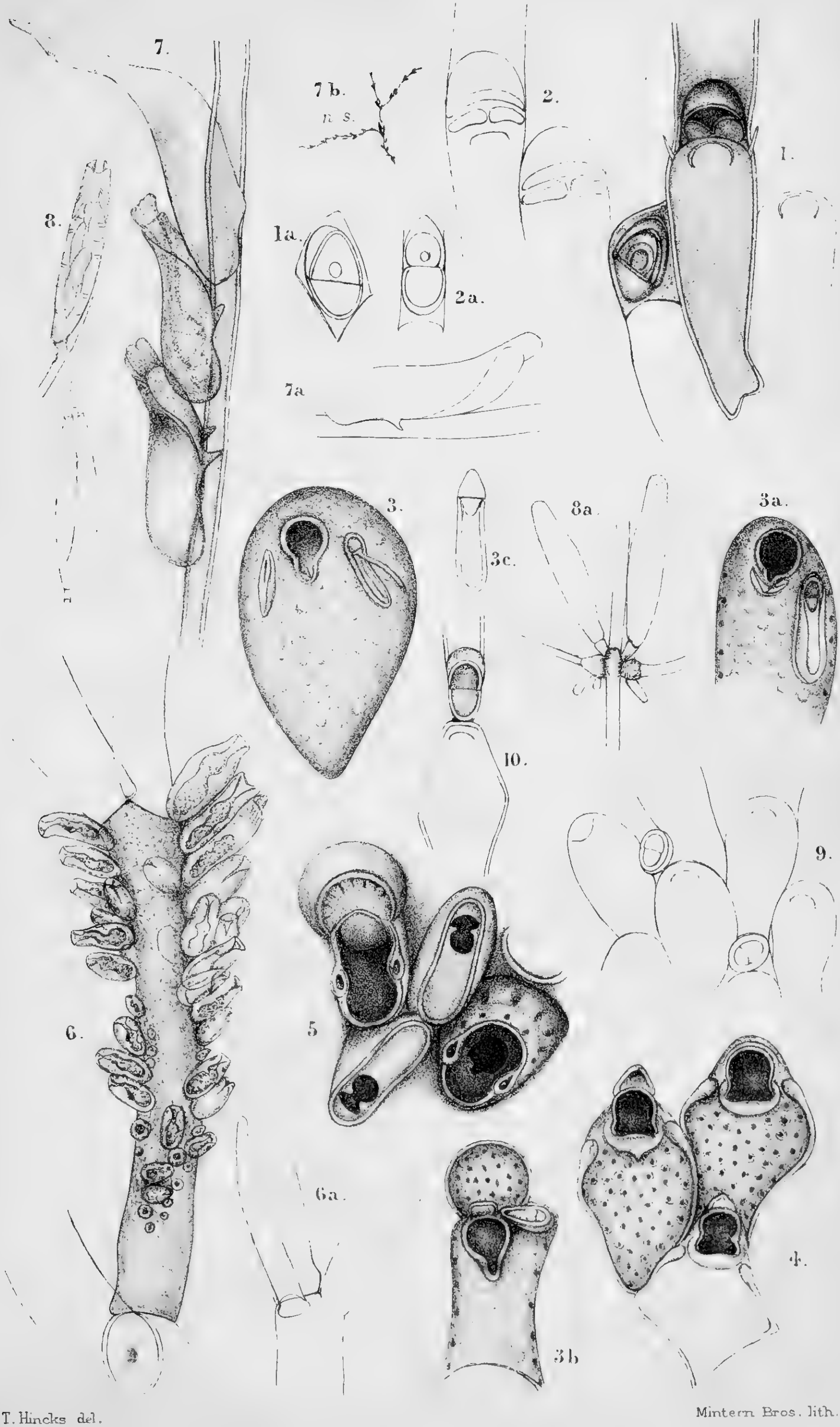
4.



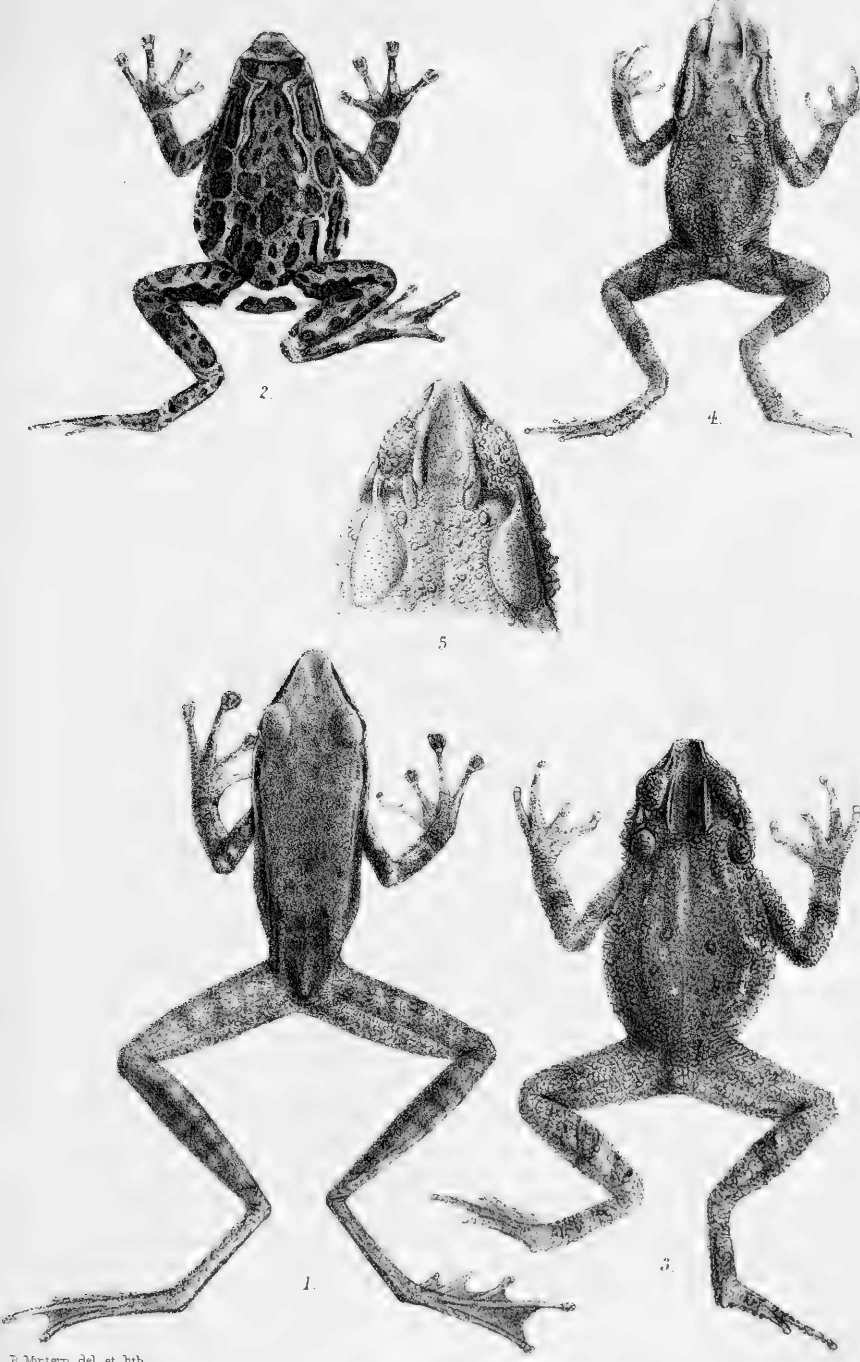
5.

Berjeau & Highley del. et lith.

Mintern Bros. imp.



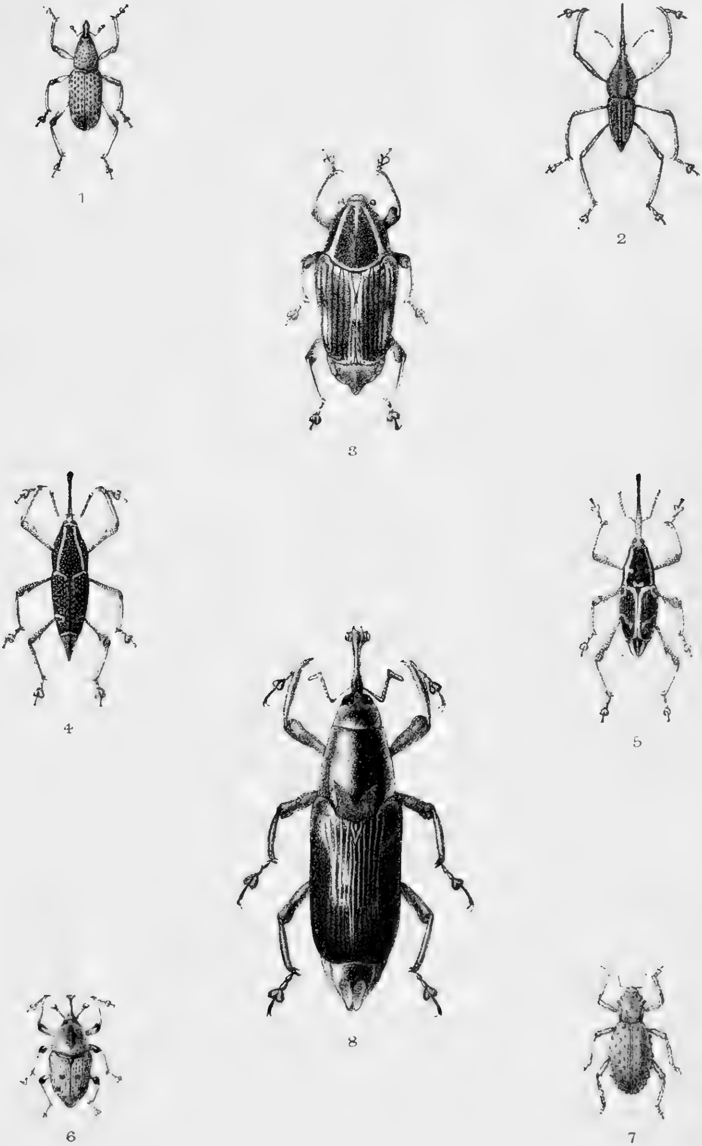
T. Hincks del. Mintern Bros. lith.



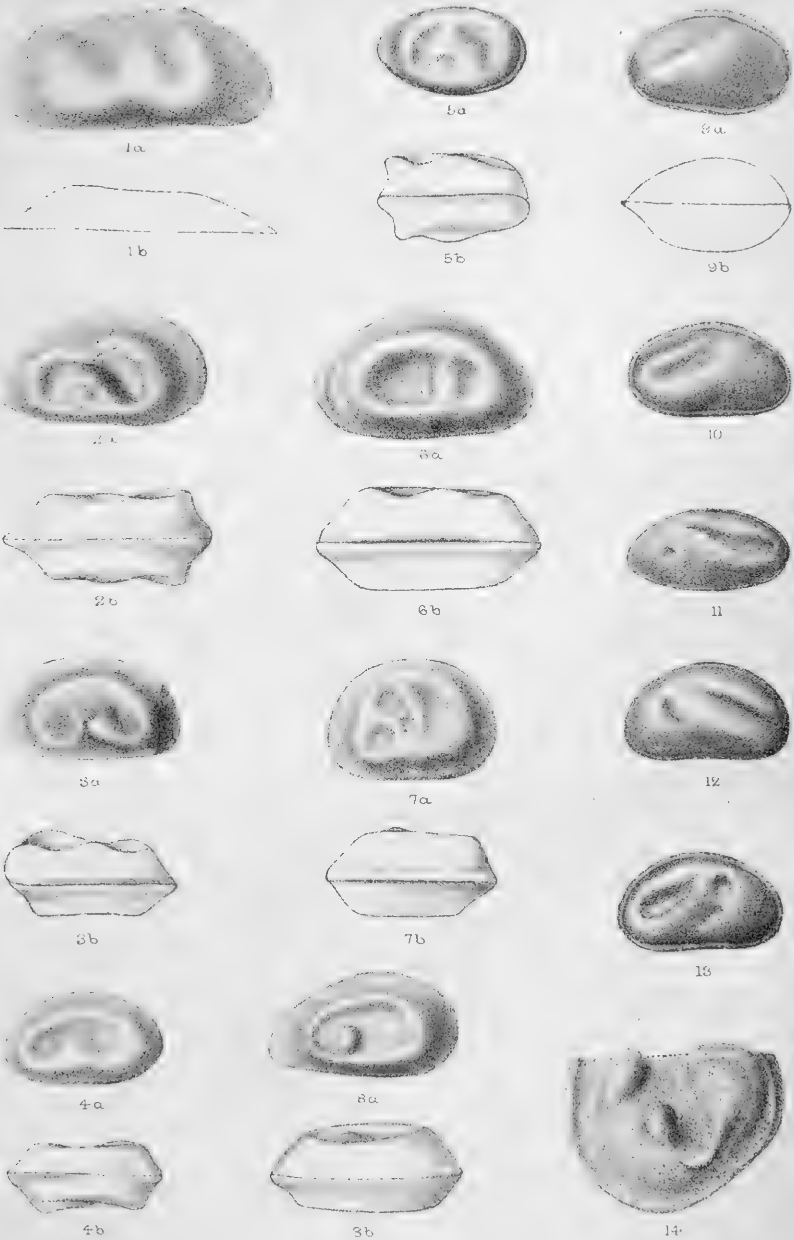
R. Mintern del. et lith.

Mintern Bros. imp.

1. Rana labialis   2. Phrynella pulchra   3. Bufo parvus.
4. Bufo quadriporcatus.   5. Bufo philippinicus.



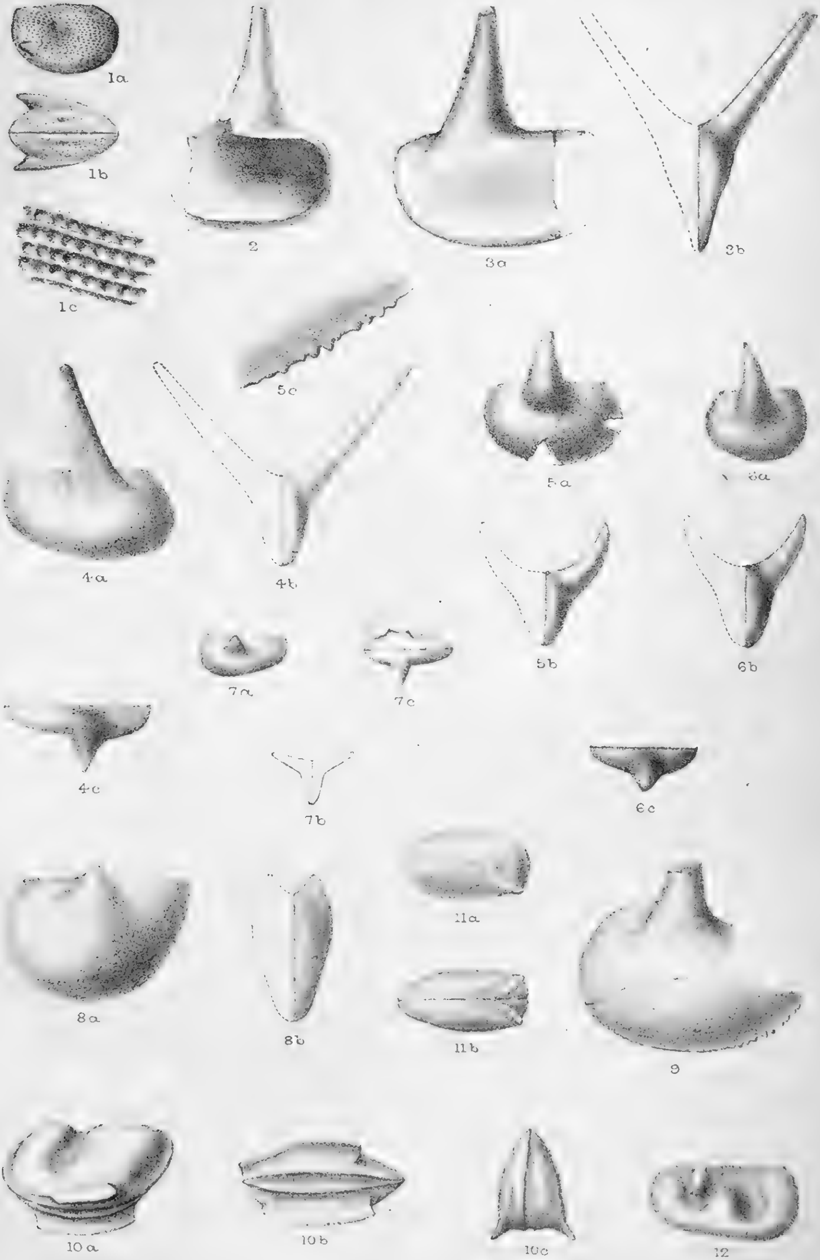
West, Newman & Co ad nat.lith.



E.C.Knight lith.

West, Newman & Co. imp.

Silurian Ostracoda.



E.C. Knight lith.

West, Newman & Co. imp.

Silurian Ostracoda.

1.

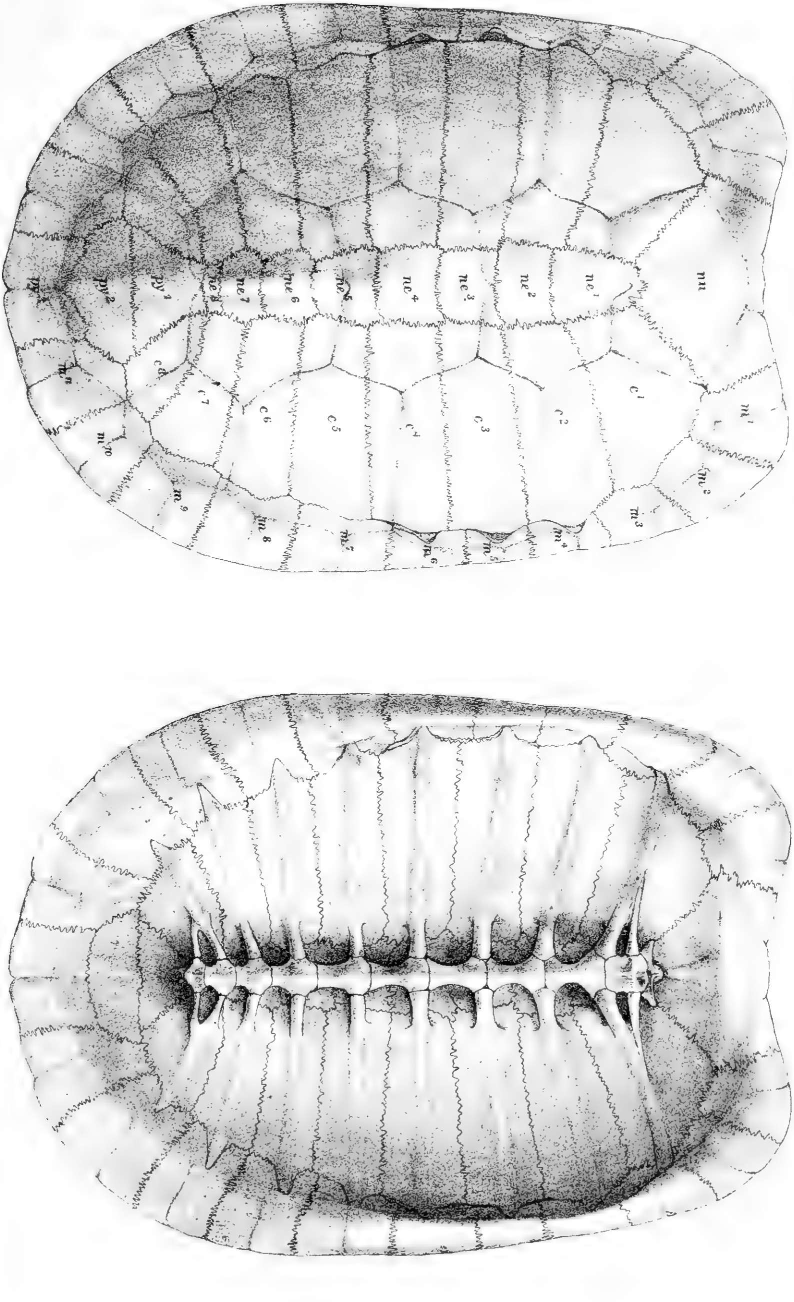
2.

Fig. 1. *Capra caucasica*, Güld.
" 2. *Ægoceros Pallasii*, Rouill.

Mintern Bros. lith.

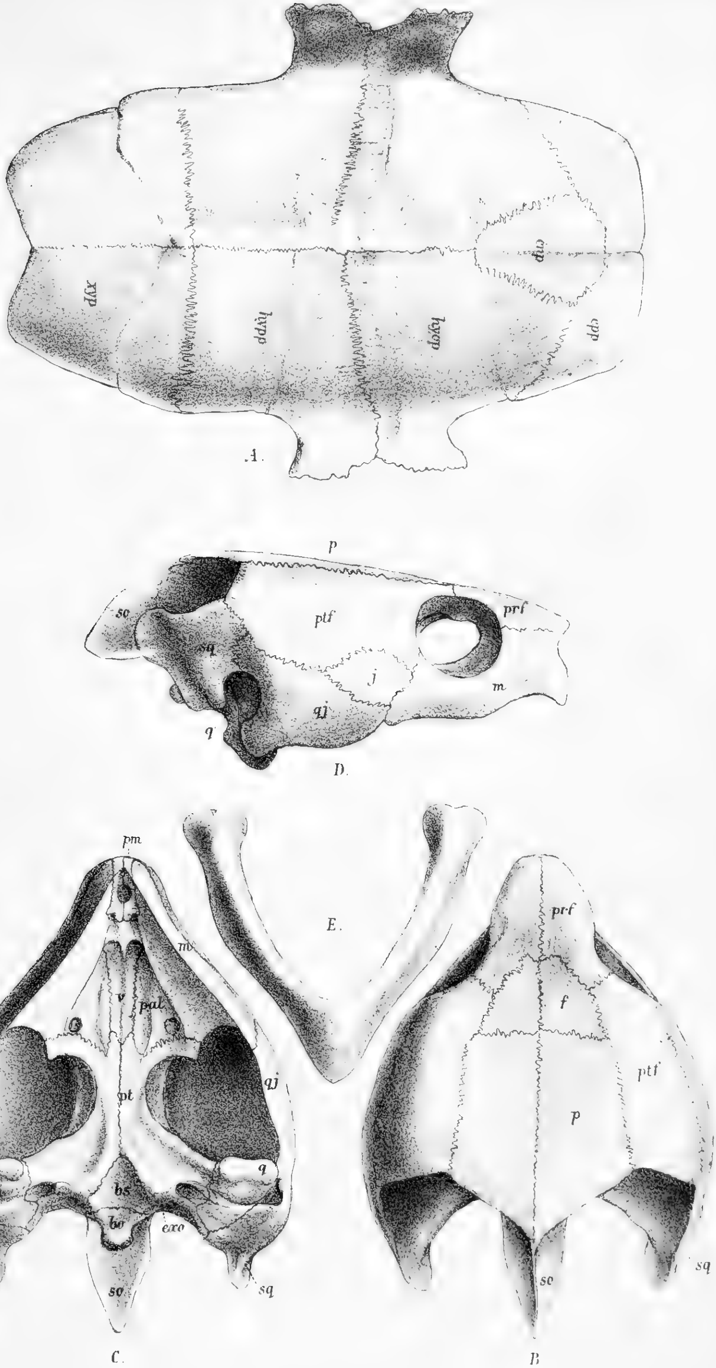
R. Mintern del. et lith.

Mintern Bros. imp.



Mintern Bros. lith.

Platysternum megacephalum.



Mintern Bros. lith.

Platysternum megacephalum.